EDITORIAL

OIL from shale is now being manufactured in commercial quantities near De Beque, Colorado. The plant has a capacity of 40 tons of shale per day.

A UNIVERSITY extension course as one of the activities of an engineering society is an innovation that has been introduced by the Oregon Society of Engineers. Mr. Otto B. Goldman and Mr. C. B. McCollough of the Oregon Agricultural College are delivering weekly lectures on various engineering subjects.

WATER was turned into the Catskill aqueduct on October 12. This project will supply New York with 500,000,000 gallons of water per day. The work has taken 12 years and the total cost will be about $177,000,000. Among the important pieces of construction involved are the Ashokan and Kensico dams and the Hudson River siphon.

ENGINEERS and others who have had experience in highway construction should pay particular attention to the announcement of the Austin Manufacturing Company on page 6 of our advertising section. This is a chance to serve your country in the work for which you are best fitted. While enlistment must be as a private, promotion will undoubtedly be rapid for those who are qualified.

HAVING your cake and eating it too is generally considered an impossibility, but the directors of the Oakdale, California, irrigation district have discovered that it can be done to a limited extent. Part of the water used on the higher lands of the district finds its way back into the river-channels, and from there is pumped to serve lower lands.

GETTING the man to the job is admitted to be one of the great problems of civilization. Even today, with an unprecedented demand for labor, there are doubtless men who are out of work, or at least are doing work other than that for which they are best suited. The Federal employment agencies are accomplishing a great deal in correcting this condition. However, the ordinary employment-agency methods are not suitable for positions in the professions, and while there has been no objection to professional men seeking employers and employers seeking professional men registering with the Federal employment agency, such registering has been uncommon. To meet this condition, the Department of Labor has established a central professional-employment agency at Chicago. Its services are free to both employer and employee. There can be no question that if such an agency is well-patronized it can be of great service. Communications should be addressed to the Teachers' and Professional Service Division, United States Employment Service, 845 South Wabash avenue, Chicago, Illinois.

STEEL and iron prices having been fixed, the next step has been to adopt regulations regarding priority of orders. Three general classes, A, B, and C have been established. Classes A and B have been subdivided into Class A-1, A-2, etc., and Class B-1, B-2, etc. Class A comprises war-work, such as arms, ammunition, and ships. Class B comprises work that, while not primarily designed for carrying on the War, yet is of public interest and essential to the national welfare, or otherwise of exceptional importance. Class C comprises other work. Orders in Class A take precedence over orders in Class B, regardless of the date received, and orders in Class A-1 take precedence over orders in class A-2. Orders in Class A and B must be accompanied by a certificate from the Priorities Committee of the War Industries Board.

Highways in Contra Costa County

In another column appears a description of the highway system of Contra Costa county, to which we would call the attention of our readers, not only on account of the engineering problems involved, but also because of the way in which administrative questions have been handled. It is often assumed, in spite of many examples to the contrary, that work on public enterprises cannot be carried on in an efficient manner. Admitting that the results are often disappointing, the fact remains that where the people, through their representatives, place the work in charge of a capable official and give him a free hand, as in the present instance, the work will compare favorably with that done under private management.

The method of financing the work is interesting. The question of bonds *v.* direct taxes for financing public improvements is one that must be settled by considering each individual case on its own merits, always remembering that the life of the bonds should never exceed the shortest life that can reasonably be expected for the improvement. Nevertheless, wherever it can be done without imposing too great a burden on the community, there is much to be said in favor of the 'pay as you go' principle. The demand that the special tax be doubled indicates that the present levy is not burdensome.

Advocates of the centralized control of county high-

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ways will be interested in the fact that the work is entirely in charge of Mr. R. R. Arnold, county surveyor. Without an official announcement of the fact, a large part of the construction and maintenance work on the county roads in general has also been turned over to Mr. Arnold. The result has been the saving, according to the statement of one supervisor, of several thousand dollars in his district alone. How many hundred thousand dollars would have been saved last year if a similar system had been in force in all the Pacific Coast States?

Turning to details of construction, the effect of the careful preparation of the subgrade can hardly be underestimated. While there is no question that the concrete slab can and does bridge over minor settlement in the subgrade, it cannot be expected to act as a beam when a large part of subgrade has dropped away.

The experience with expansion-joints is typical of many California communities. Whether or not the use of such joints is advisable in other parts of the country, they do not seem to be worth while in California. Given a little time, Nature will supply the necessary joints, and if these are properly repaired they will cause no more trouble nor expense than the artificial ones.

The strength of the concrete produced is remarkable. Few of the cubes tested gave a strength of less than 3000 pounds at 28 days, and some gave over 4000 pounds. It almost seems as if Mr. Arnold and his contractors had discovered some magical and hitherto unknown method. This, however, is not the case. It is simply a question of good materials, careful grading of aggregates, thorough mixing with a reasonable amount of water, and the removal of the excess water by tamping, after the concrete is placed.

Probably the excellent character of the concrete has had a good deal to do with making feasible the abandonment of an asphaltic wearing surface. Concrete roads both with and without an asphaltic surface are a comparatively new thing. Time alone will show whether, given a concrete base, it is best to lay an asphaltic wearing surface or to devote the same amount of money to more, or possibly richer, concrete.

The San Jose Bridge Failure

As we go to press comes the report of the failure of a bridge across Coyote creek in San Jose. Details are lacking but it appears that the bridge collapsed under the weight of several standard freight-cars that were crossing it on the tracks of an inter-urban railroad. The train-crew was uninjured, but a pedestrian was killed. The cars and their contents were somewhat damaged, and the bridge itself is a total loss, except for its junk value.

At the time of its construction a number of years ago, the bridge was quite strong enough for ordinary pedestrian, vehicular, and street-car traffic. In recent years the weight of the street-cars crossing the bridge have increased materially, but it is probable that this would have caused no trouble if the inter-urban company had not re-built several miles of line through the agricultural country west of the city and commenced to haul short trains of freight-cars across the bridge to a connection with the Southern Pacific railroad. Several months ago the city engineer made an examination, which showed that the bridge was not strong enough to stand such treatment. Plans were prepared for a new bridge but the project was postponed on account of the condition of the steel market. There appears to have been an agreement that in the meantime, running one car at a time was to be permitted. This regulation was not observed. Whether or not the city officials were aware of this is relatively unimportant. The important facts are that it was not observed and that the bridge failed.

The bridge will be re-built and it is probable San Jose and the adjacent communities have learned a valuable, as well as an expensive, lesson. It would, however, be a pity if that was all. Nobody knows how many bridges there are throughout the country carrying heavy inter-urban cars and occasional freight-trains, which were never designed for this work. They were entirely adequate when they were built for the vehicular traffic of that day, and even a light street-car. Now, however, only the mercy of Heaven and the factor of safety preserves them from failure. The use of inter-urban electric lines as feeders for the trunk-lines is an important factor in keeping in check the rising cost of living, and should be encouraged. Nevertheless, would it not be advisable for city and county authorities to make a survey of the bridges under their jurisdiction, and in cases where a bridge was overloaded and immediate strengthening or replacement was not feasible, to enforce such regulations as would insure safety?

There is another aspect of this bridge-failure that deserves mention. The entire affair is likely to be used as a basis for attacks on the city-manager plan in general and the city administration of San Jose in particular. Most of us recognize that some of the advocates of the city-manager plan have been too enthusiastic. Adopting a city-manager charter does not immediately bring the millenium to a town, nor will it enable the voters to turn all their worries over to the city manager and go to sleep on the job. That is not the democracy that we are fighting for at this time. Nevertheless, both theory and practical experience indicate that good government is more likely to be attained under the city-manager plan than under any other system that has been tried in America.

Neither is sweeping condemnation of the city officials of San Jose justifiable. It is quite easy now both to see and to say that they should have made sure that excessive loading of the bridge was prevented, and they would be the last to try to escape blame for it. It should, however, be remembered that the members of several earlier administrations are no less blameworthy, merely more fortunate, in that the bridge lasted through their terms of office. Furthermore, the fact remains that San Jose is better governed now than ever before.

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REVIEW OF THE MONTH

CONGRESS has adjourned after a six months' special session devoted to war-problems. Some dissatisfaction has been expressed from time to time with the delays in the passage of some measures, but surely the enactment of the conscription bill, the food-control measure, the war-tax bill, and the various appropriation bills, both for such special needs as the merchant marine and the aeroplane fleet and also for the general carrying on of the war, would indicate that our lawmakers had done something else besides talk.

THE particular piece of legislation that will have the greatest effect upon the lives of the whole people, engineers included, is doubtless the war-tax bill. If the only popular tax is the one that the other fellow pays, then this measure will be one of the most unpopular in history, for it is difficult to conceive of anyone's contriving to escape its provisions. This is a war for, of, and by the people, and it is right that everyone should have a share in paying for it, and know that they are paying for it. The taxes imposed are large, it is true, but let us pay them as cheerfully as we can.

THERE has been considerable criticism of the excess-profits and income-tax sections of the bill, both from those who thought these taxes were too large and from those who thought that they were not large enough, the latter objectors making the most noise. It should be remembered, however, that the present situation demands that every man and every dollar should work full time. It is safe to say that so far, the dollars of America have shown themselves more patriotic than the labor of America. But even the patience of the dollars is not unlimited, and they too will go on a strike if denied a living wage. The provisions of the bill will appear to have been drafted with the idea of taxing the rich as much as possible without actually discouraging the investment of capital. Taking the income and excess-profit taxes together, there is little chance of anyone, except a few farmers and skilled laborers, making much money out of the War.

RELIEF legislation for the Californian oil-operators, as well as the passage of a leasing bill, has been postponed again, Congress having adjourned with these matters still unconsidered. It is generally understood that this was mainly the result of opposition to relief legislation, as far as the naval reserves are concerned, on the part of certain Federal officials. Since these officials are likely to remain in office, the outlook for general relief legislation is not hopeful. As a matter of expediency, it might become advisable for the oil-men to abandon the attempt to obtain legislation affecting the naval reserves and concentrate their efforts on a practicable leasing bill combined with relief for the bona fide operators on land outside the reserves, trusting to the courts to grant justice to the operators within these tracts. Recent decisions have shown a tendency on the part of the courts to construe the law liberally where the good faith of the operator on the date of withdrawal is plainly shown.

MEANWHILE the statistics of oil production show a condition that is far from satisfactory. Although the completion during July and August of a few particularly good wells, which have not yet passed their first 'flush' production, resulted in a slightly increased output during September, the excess of shipments over production for the month was 567,000 barrels. The present available stock on hand is about half what it was two years ago. That Federal litigation and the general uncertainty regarding the withdrawn land is largely responsible for the present shortage is indicated by a comparison of the September production statistics of the more important fields with those of the same month last year. In the Whittier-Fullerton and the Santa Maria fields, where there is no litigation, the daily production is, respectively, 16,000 and 6000 barrels greater than last year. At Coalinga, where litigation affects the Southern Pacific lands only and there is practically no unpatented oil-land, the daily production has increased 4000 barrels. In the Midway-Sunset fields, on the other hand, where a large part of the most productive land is in litigation, and more is likely to be, the production is actually 4000 barrels per day less than in 1916. As was to be expected, it has not been feasible to drill enough wells in the Kern River field to compensate entirely for the decline in production of old wells.

AN important legal decision regarding the paving of a street that has been accepted once, has recently been rendered by the Supreme Court of California in the case of Ransome-Crummey Co. *v.* S. F. Bennett *et al.* The case concerned a street in San Jose that had been improved in 1889. Increase of traffic ultimately required a more substantial surface, and a pavement composed of a two-inch asphaltic wearing surface on a six-inch concrete base was ordered laid by the city council. After the work was completed, certain property-owners refused to pay their share of the cost, on the ground that the street once having been accepted by the city, they were freed of expense for re-paving as well as repairs. This the court denied, holding that "It would be a violation of a proper constitution of the term repair

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to hold that it included an original improvement of a street or work of a different character from that previously done," and further that "the exemption from future taxation awarded to property-owners who have paid for the improvement of a street fronting on their land is a gratuity, and is therefore subject to repeal by the legislature at any time, without inflicting upon the property-owner any grievance." There are many cities in California that have accepted streets surfaced with gravel or macadam in the dim distant past, and upon which the surfacing is now only a memory. Really substantial pavement, however, has been an impossibility, because the property-owners took refuge in the original acceptance of the street and the city could not or would not pave the streets at the expense of all the taxpayers of the city. The present decision will allow this work to be done at the expense of the owners of abutting property.

RECONSTRUCTION of the Lower Otay dam is now under way, the contract having been signed on October 11 by James Kennedy of Los Angeles. The dam will have a gravity section, and will be of the arched type. It will contain over 50,000 cubic yards of concrete and the total cost will probably be somewhat greater than the bond issue of $682,200. The contract calls for the completion of the structure by December 31, 1918, barring accidents and other unavoidable delays. In other words, all or nearly all the concrete must be deposited during one working-season. The original dam was a rock-fill structure with a concrete and sheet-iron core-wall. It was destroyed by a storm on January 27, 1916.

MAKING both ends meet is an almost universal problem in these days of rising costs. In some cases, the manufacturer or merchant is able to find an answer to the problem in increased sales. More often he simply puts his prices up, which may be a satisfactory solution for him, but seldom helps the general problem. The regulated public utility has no such easy recourse, but must apply to the governing commission for authority to increase rates. Sometimes this petition is granted; more often it is not. The street-railway corporation finds it particularly difficult to raise its rates. The five-cent fare is a legacy from the old horse-car days, when hauls were short and rails and other equipment light and comparatively cheap. Now that hauls are long and equipment expensive, the street-railway manager finds that nickel is an extremely inelastic substance.

SIX-CENT fares are suggested as a means of meeting this situation, which is admitted to be serious in many communities. Public-service commissions have granted such increases in some Eastern cities, and applications have been made in a number of other places. The Oregon State Public Service Commission has recently denied permission to the Portland Railway, Light & Power Company to charge a six-cent fare, while admitting that the revenues of the company were inadequate. Increases in special reduced fares were allowed, but these will make a relatively small amount of difference in the total revenue. Permission for some reduction of service was granted, and attention was called to unjust burdens under which the company now labors, such as the obligation to maintain pavements, and also to carry municipal employees free of charge. The commission also expresses the pious, and it seems to us not very well founded, hope that the measures suggested will solve the difficulties outlined.

REMOVAL of the unjust burdens mentioned above, in the case of most street-railway companies, would probably be a more feasible and just as effective a method of meeting the situation as increasing the fare. Like the five-cent fare, the obligation to construct and maintain part of the street pavement is a relic of the horse-car days, when the horses' feet did result in concentrated wear. There is no excuse for it at the present time. Carrying city employees free never did have any excuse. It is simply an unbusinesslike attempt on the part of the municipality to get something for nothing. For the city to take a given percentage of the gross receipts of the company without finding out whether or not there are going to be any net receipts is also indefensible. No one denies that a street-railway is an asset to a city and to each of its inhabitants. For a company to give this service to a community at a loss, and then to be taxed for the privilege of doing so, is both absurd and unjust. The only reasonable payment by a street-railway to a city is a proportion of the net receipts after all charges including depreciation and a fair interest on money invested have been deducted. This is the rule under the indeterminate-franchise plan in effect at Chicago and Kansas City, and which has been approved, although not yet made effective in Oakland, Alameda, and Berkeley.

TEMPORARY structures are being eliminated on most Western trunk-line railroads as well as elsewhere in the country. A combined fill and concrete-arch structure recently replaced the Dollarhide trestle, 40 feet high and 600 feet long, on the Southern Pacific railroad north of the Siskiyou mountains. The fill contained 70,000 cubic yards. One of the arches was 102 feet and the other 120 feet long. With one exception, every opening on the Portland division of the Southern Pacific railroad is now spanned by either a concrete or a steel structure.

THE problem of the economic construction of highways has been solved in a certain California county. A recent item in a local daily paper states that the Board of Supervisors called for bids for the construction of some oil-macadam highways. The bids received were higher than had been anticipated, so it was decided to build the roads by day-labor and save money. How strange that none of us thought of this simple expedient before!

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Concrete Highway Construction in Contra Costa County

Contra Costa county is situated on the south-eastern shore of San Francisco and Suisun bays. The northern and eastern parts of the county are mainly level and there are also several rather narrow valleys in the southern and western parts, although these districts are mainly hilly. Proximity to deep water has contributed to the growth of several industrial towns along the bay shore, while most of the rest of the county is devoted to agriculture and grazing. The population of the county in 1910 was 31,674 and of Martinez, the county-seat, 2115. The industrial development of the towns along the bay shore and the agricultural development of the rest of the county has resulted in a considerable increase of population since that time.

The State highway will run from the Alameda county line near Richmond to Martinez, about 20 miles. At this point it crosses Suisun bay to Benicia and continues northerly through Solano and the other counties of the Sacramento valley. With the exception of some small stretches in incorporated towns, the State highway is either completed or under construction. The county highway system will consist of a road from the tunnel at the county line through the hills back of Oakland easterly to the county line near Byron, and a road southerly from Martinez to the county line near Dublin, 76 miles in all. Instead of issuing bonds, funds for the construction of the system are provided by a special tax of $0.25 per $100 assessed valuation. With the present asessment, this will provide for the construction of about 11 miles of road per year, so that the system will be completed in seven years from the commencement of work in 1915. There is, however, a strong movement to increase the special tax to $0.50 per $100, so that it is likely that the highway system will be completed in less time. This is a good indication that the present tax is not burdensome and that the people as a whole are satisfied with the work.

Divisions No. 1 and 2, 10¼ miles in all, comprised the so-called 'Tunnel' road from Oakland to Walnut Creek. This work was commenced in 1915 and completed in the spring of 1916. Contract for construction of divisions No. 3 and 4 was awarded July 24, 1916, to O'Brien Bros., of Martinez. Work on division No. 3 from Byron south-easterly was completed during 1916, while part of the work from Byron north was done the following spring. Work on division No. 4 was finished during 1916 except for laying the concrete on a few high fills. These were allowed to settle during the winter and the concrete laid the following spring. It might be stated, however, that the embankments had been so thoroughly compacted during construction that there was no appreciable settlement.

Bids for the construction of divisions No. 5 and 6, each about five miles long, were opened on July 2 of this year, this being about as early as the work could be let, on account of the money from the tax-levy not being available until July. Contract for the construction of division No. 5 was awarded to O'Brien Bros. at the following unit prices:

Line excavation, 40,000 cu. yd.	$0.62
Bridge and culvert excavation, 760 cu. yd.	1.00
Overhaul, 4200 cu. yd.	0.02
Reinforcing steel, 43,000 lb.	0.08
Concrete in pavement, 7817 cu. yd.	10.25
Concrete in bridges and culverts, 580 cu. yd.	14.50
Placing wire-mesh reinforcement, 57,000 sq. ft.	0.005

Contract for division No. 6 was awarded to Tibbitts-Pacific Co. of San Francisco. The unit prices were as follows:

Line excavation, 35,000 cu. yd.	$0.58
Bridge and culvert excavation, 370 cu. yd.	1.15
Overhaul, 150,000 cu. yd.	0.015
Reinforcing steel, 39,000 lb.	0.07
Concrete in pavement, 6350 cu. yd.	10.20
Concrete in bridges and culverts, 291 cu. yd.	18.00
Placing wire-mesh reinforcement, 47,000 sq. ft.	0.015

In this connection it is interesting to note the prices on divisions No. 3 and 4 last year.

	Division No. 3	Division No. 4
	7.14 miles	3.49 miles
Line excavation, per cu. yd.	$0.48	$0.38
Bridge and culvert excavation, per cu. yd.	1.00	1.00
Overhaul per 100 ft., per cu. yd.	0.01	0.01
Concrete in pavement, per cu. yd.	7.48	7.28
Concrete in bridges and culverts, per cu. yd.	11.00	11.00
Piling, per lin ft.	....	1.00
Steel, per lb.	0.07	0.07
Total	95,705.86	53,540.00

The methods of construction on divisions No. 3 and 4 were described in WESTERN ENGINEERING for December 1916, and the same practice has been followed this year, with some important differences, which will be noted below. In brief the general procedure is as follows:

An 18-ft. concrete pavement is constructed, 4 in. thick at the sides and 5½ in. at the centre. A 1:2:4 mixture is used, graded to give a minimum proportion of voids. A batch-mixer is employed, making 14 to 16 revolutions per minute. After all the materials are in the drum, it is revolved for one minute before the concrete is discharged. The header-boards of 2 by 6-in. Port Orford cedar are allowed to remain in place.

Last year earth shoulders 6 ft. wide were constructed on each side of the concrete, but it was found that these held the water draining from the pavement as well as that falling on the shoulders, and that these wet shoulders, besides being objectionable in themselves, tended to disturb the sub-grade. This year narrower shoulders of rock are being constructed.

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Probably the most important change from last year's practice has been with regard to expansion-joints. These were of prepared felt and had been placed 35 ft. apart. A great deal of trouble, however, was experienced with these joints from chipping at the edges of the pavement on both sides of the joint. This is probably caused by an excess of moisture in the concrete and the subgrade at the edges of the pavement during the curing-period, tending toward expansion and the creation of a plane of weakness at each joint. Regular spacing of joints has been abandoned this year, joints being placed only at the end of the day's work, at noon, and at other times when work is stopped. It might also be stated that outside of the expansion-joints there has been practically no trouble with cracks or other defects in the concrete placed a year ago.

The fact that the proper kind of subgrade is half or more than half the battle in the construction of a concrete road has been recognized. Fills more than one foot high are constructed in one-foot layers, each layer being diked and flooded before the next layer is placed. In all cases, the sub-grade is plowed, rolled, harrowed, watered, and then rolled again. The final finish is given with a road-planer that runs on the header-boards and is drawn by six horses. The knives of this planer give a true surface as smooth and hard as the concrete that is to be laid on it. The character of the subgrade after this operation has been completed can be judged from the following: The sand and crushed rock are dumped on the subgrade ahead of the mixer. This necessitates a number of heavily-loaded teams traveling over the new subgrade. Where the original soil is favorable for a firm subgrade, it requires a close examination to discover any wheel-tracks after the concrete-materials have been distributed. Where the soil does not make a good subgrade, wire-mesh reinforcement is used.

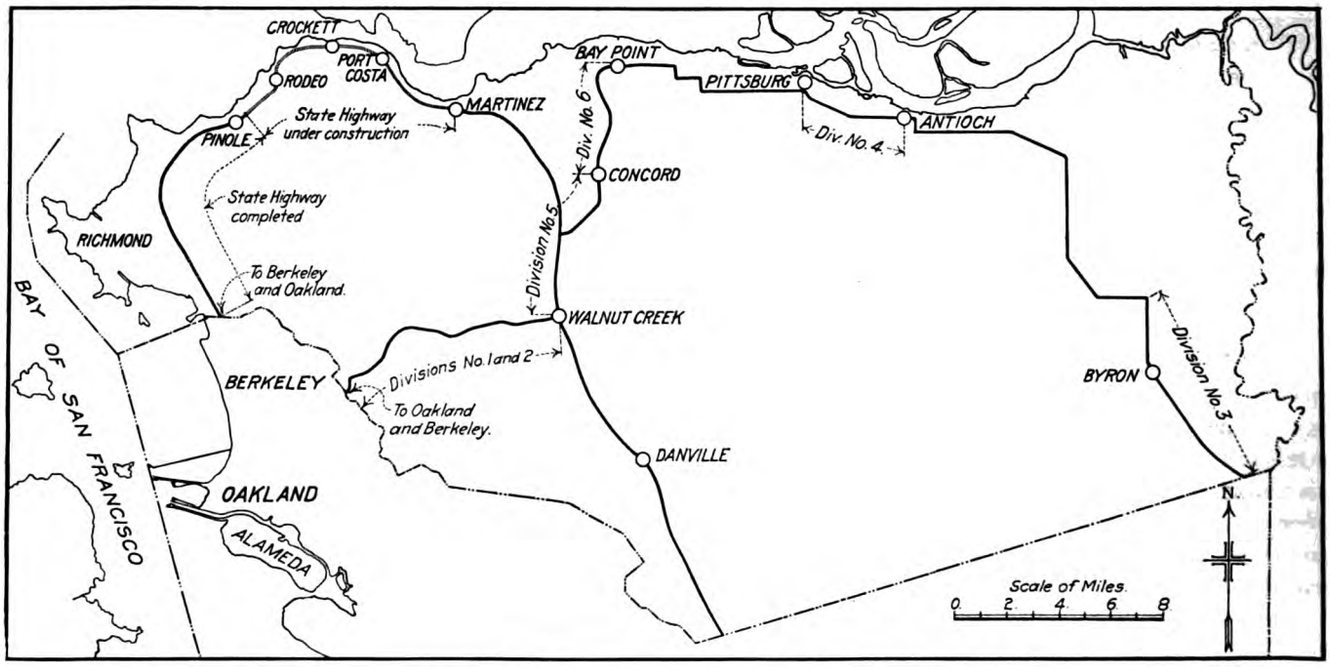
Specimens of the concrete, consisting of 6-in. cubes, are made and tested frequently. The average compressive strength of 35 cubes, taken at various times, and tested at 28 days by R. E. Noble & Co. of San Francisco, was 3195 lb. per sq. in. The lowest strength was 2332 lb., while two specimens exceeded the capacity of the testing machine, 150,000 lb., showing a strength in excess of 4167 lb. per sq. in. One cube showed a strength of 1445 lb. at 7 days.

As with the work done last year on divisions No. 3 and 4, no asphaltic surface is being placed on divisions No. 5 and 6. The concrete is mixed fairly wet so that it will flow easily. After it is poured, it is brought to grade and struck off with a heavy wooden template. This template and a lighter one are used to 'pound' the concrete until the excess water is brought to the surface. The surface is then finished smooth by hand-floating from a bridge. Wooden floats are used. When the concrete has hardened sufficiently, it is covered with earth, diked and ponded, and kept wet for ten days. Traffic is kept off the pavement for three weeks from the time the concrete is poured.

Most of the cement used has been the Mt. Diablo brand manufactured by the Henry Cowell Lime & Cement Co., although other brands have been used when it was more convenient. Sand, gravel, and crushed rock have been obtained from the Grant Rock & Gravel Co., the Niles Sand & Gravel Co., and the Natomas Co. of California.

As a general rule, cuts are made 36 ft. wide and fills 30 ft. wide. On the sharp curves the pavement is widened to as much as 24 ft. The curves ar superelevated according to the following formula:

$$\text{Elevation} = \frac{0.06688 \times w \times v^2}{R}$$, in which $w = 18$ ft., $v = 30$ miles per hour, and $R =$ the radius of the curve.



MAP OF CONTRA COSTA COUNTY SHOWING HIGHWAY SYSTEM

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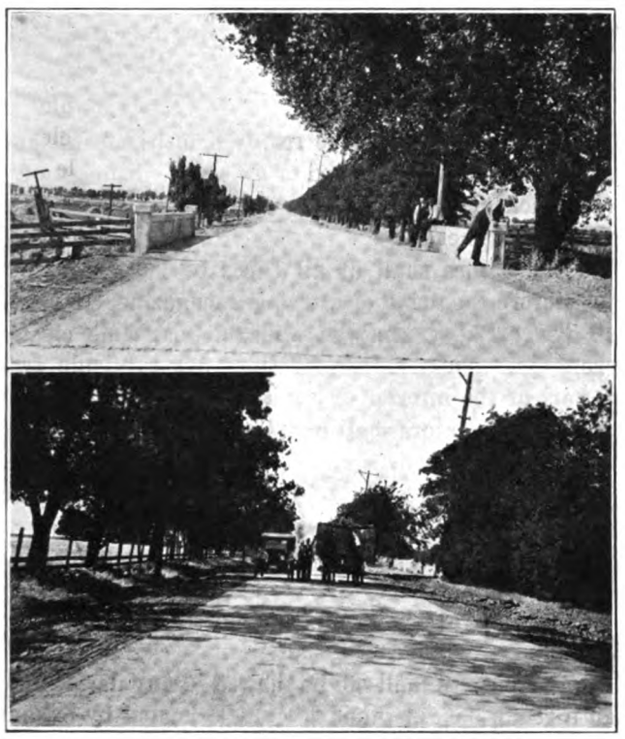
The maximum super-elevation used is 1.6 ft. for curves in which R is equal to or less than 677.16 ft. The super-elevation, wherever practicable, is begun not less than 50 ft. from each end of the curve, and at a greater distance where the grade is heavy. The inner edge of the



PARTS OF COMPLETED HIGHWAY

pavement is kept either level or on the ruling grade. Vertical curves are figured according to the formula: Middle ordinate =

$$\text{Elevation at } B - \frac{\text{elevation at } A + \text{elevation at } C}{2}}{2}$$

where A and C, respectively, are the beginning and end of the curve and B is the point of intersection of the two grade-lines produced. Ordinates from intermediate points between A and B and C and B vary as the square of their distances from B.

The work has been done under the direction of Ralph R. Arnold, county surveyor of Contra Costa county with E. S. Arnold as consulting engineer.

An electric fan that combines some of the principles of a windmill with those of a water-wheel has been placed on the market. A cylindrical paddle-wheel rests in a shallow semi-cylindrical tank of water, which is cooled by contact with a small compartment of ice. A small electric fan is placed so as to play on the paddle-wheel. The air-current turns the paddle-wheel slowly, and the air passing between the blades is cooled by contact with the particles of water carried along by the wheel. The machine is said to be able to reduce the temperature of a room considerably.—'Refrigeration.'

REMOVAL OF SILT FROM SEWERS

The use of balls made of sheet zinc to assist in flushing silt from sewers is discussed by E. B. Shifley, city engineer of Owensboro, Kentucky, in 'The American City.' If a sewer is simply flushed with a stream from a fire-hose, the silt is forced forward by the rush of the water. The outlet from the sewer becomes choked, causing the water to back up and lose its velocity and effectiveness. If, however, a ball is used ahead of the water the sewer is kept open by the increased velocity of the water around the ball.

In case a sewer is choked, a ball between 5 and 10 in. smaller than the pipe-diameter is put into the sewer at a manhole. A fire-stream is applied behind it until the ball appears at the next manhole. The silt which has come through both before and after the ball is removed from the manhole, and another ball of slightly larger diameter than the first is placed in the sewer. This is continued with larger balls until the sewer is clean. To ensure a perfectly clean sewer the last ball is 2 in. smaller than the sewer diameter. When sewers are not silted badly, and yet it it thought advisable to clean them, larger balls are used at the start, thereby saving time and water.

Many experiments with wooden and zinc balls were tried when this method of cleaning sewers was devised. It was found that wooden balls were of little use. Nevertheless the balls must float, rolling along the top of the sewer to be most effective. To secure this, balls of No. 24 gauge sheet zinc were made with two thicknesses of the metal and the seams at right angles. The diameter of the balls used ranges from 4 to 22 inches.

In using these balls to clean the sewers, work is begun at the upper manhole of any lateral and continued down grade. It has been found necessary to place a screen directly in front of the opening into the manhole, with a sand-bag behind it in order to catch the grit and prevent it from going down into the next section.

Standard designs for motor trucks have been prepared by the Quartermaster Corps of the Army, working in conjunction with commercial truck manufacturers and members of the Society of Automotive Engineers. Deliveries to the Government are being made as rapidly as possible. There will be two models, class A and class B. The engines used in the two will be similar in design, except for slight differences in cylinder-bore, pistons, piston parts, and riggings. To a large degree interchangeability of parts will be possible. The class A model will have a normal carrying capacity, under the arbitrary official ruling, of 1½ tons, with an actual commercial capacity of 3 tons. The class B truck will have a normal capacity of 3 tons and an actual capacity of 5 tons. Both trucks will have a two-wheel drive, with a speed requirement of 11 miles per hour for the class A trucks and 12 miles for class B trucks.

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General Construction Safety Orders of the California Industrial Accident Commission

Tentative General Construction Safety Orders have been prepared by the Industrial Accident Commission of California. Two committees were appointed, one to meet in San Francisco and the other in Los Angeles. On these committees were representatives of the architects, civil engineers, contractors, and employees in the building trades. The commission's representatives were John R. Brownell, superintendent of safety, and J. J. Rosenthal, safety engineer, on the San Francisco committee and L. A. Pockman and H. L. Boyd, safety engineers, on the Los Angeles committee. In accordance with its general policy, the commission has issued Tentative Orders, to be discussed at meetings open to the general public. Suggestions made at these meetings will be referred back to the committees and discussed before the final orders are issued. Public meetings were held October 18 at San Francisco and October 25. Some suggestions were made at the San Francisco meeting, but so few as to indicate that the preliminary work of the committees had been well done. At the time of going to press, no report of the Los Angeles meeting was available.

The Tentative Orders are as follows:

Order 1100: Application: These orders shall apply to the construction, alteration, repairing, renovating, removal, or wrecking of buildings or other structures within this State.

Orders No. 1101 and 1102 define the terms contractor, superintendent, etc., and provide for yearly reports to the superintendent of safety by every contractor in the State regarding number of men employed and total payroll.

Order 1103: Excavations.

All excavations shall be properly shored and braced or otherwise retained as may be necessary to prevent the sides from caving.

Order No. 1104 comprises the State law regulating the manufacture, storage, and selling of explosives, adopted in 1911 and amended in 1917.

Order 1105: Storage and Use of Explosives.

(1) Magazines shall not contain tools other than a wooden mallet and wedge or a phosphor-bronze chisel.[1]

(2) When supplies of explosives or fuse are removed from a magazine, those that have been longest in the magazine shall be taken first. Packages of explosives shall be removed to a safe distance from the magazine before being opened, and such package shall be opened only with wooden or bronze tools. Empty or broken boxes, paper, and rubbish shall not be allowed to accumulate within 100 ft. of a magazine. Such boxes, paper, and rubbish shall be removed to a safe distance (at least 500 ft.) and burned or otherwise disposed of.

(3) Packages containing explosives shall not be opened in a magazine.

(4) Magazines shall at all times be kept clean and dry. Before repairing or altering a magazine, explosives shall be carefully removed and the magazine cleaned thoroughly. Nails or screws must not protrude from any part of the interior of a magazine.

(5) No detonators shall be taken into a magazine containing other explosives.

(6) No detonators shall be transported in the same receptacle with other explosives.

(7) Detonators shall not be removed from original container except as they are used for capping fuses.

(8) Explosives shall not be thawed in a magazine where other explosives are kept.

(9) Explosives shall not be thawed in any device other than a room, box, or other receptacle heated by exhaust steam, hot water, manure, or electricity. If steam or water be the agent employed, the stove, boiler, or other primary source of heat shall not be nearer to the thawing-room than 10 ft. Explosives shall not be thawed by direct contact with steam. If electric current be the thawing agent, the current shall not be brought within 5 ft. of the explosive to be thawed, and in no case shall explosives while being thawed be exposed to a temperature higher than 80° Fahrenheit.

(10) Explosives shall not be placed or left within 5 ft. of live electric wires.

(11) Explosives shall not be kept exposed to the sun any longer than is necessary. Explosives deteriorate under the direct heat of the sun.

(12) No person shall remove explosives from a magazine without the written or verbal orders of the superintendent or foreman of the job.

(13) Fire-extinguishers or hydrants and hose shall be provided and kept ready near all powder-magazines for use in case of fire outside the magazine.

(14) Smoking in a powder-magazine or while handling powder, or entering a magazine with an open light is prohibited.

Order 1106: Fuse.

(1) No fuse shall be used for blasting that burns faster than 1 ft. in 30 sec. or slower than 1 ft. in 55 sec. Only fuse of sufficient length shall be used so as to allow the men to retire to a point of safety before firing a hole or round of holes.

Under no circumstances shall fuse less than 2½ ft. long be used.

(2) Caps and electric fuses are extremely sensitive,

[1] At the San Francisco meeting, the omission of the clause following the word 'tools' was suggested.

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hence it is forbidden to carry them in one's pocket or store them in buildings except a magazine as specified in these Orders.

(3) The use of oil or grease to waterproof joints between cap and fuse is forbidden. This practice causes misfires. The use of a compound sold by powder manufacturers for waterproofing, such as roofing paint, celakap, etc., is recommended.

(4) In capping fuse, at least 1 in. shall be cut from the end of each coil of fuse to be used in blasting. (This will prevent damp fuse-ends from getting into the cap.)[2]

(5) Only a crimper[3] shall be used for attaching fuse to blasting cap. Crimping with the teeth or a knife is strictly forbidden. Crimpers shall be provided and kept in good repair ready for use.

(6) It is forbidden to use fuse that has been hammered or injured by falling rocks or from any other cause. (Such injury may increase the rate of burning, or may render the fuse entirely useless.)

(7) In cold weather, fuse shall be warmed slightly before uncoiling, to avoid cracking the fuse.

(8) The hanging of fuse on nails or other projections, which cause a sharp bend to be formed in the fuse, is prohibited.

Order 1107: Blasting.

(1) All bore-holes shall be cleaned thoroughly before loading. A bronze, wooden, or heavy-paper funnel shall be used to load bore-holes.[4] It is forbidden to use anything but wooden tamping-rods, with no metal parts, in loading explosives or tamping material in the bore-holes, and it shall be the duty of the bosses or shot-firers to see that no metal tools are used for tamping. Detonators, when used in firing blasts, shall be of not less strength than No. 6, containing[5] one gram of fulminating composition. It shall be the duty of the superintendent or foreman to fix the time of all blasting and firing. Bosses or shot-firers, and workmen about to fire shots, shall cause warnings to be given in every direction, and all entrances to the place or places where charges are to be fired shall be guarded so far as possible.

(2) The number of explosions in every blast, except in cases of simultaneous firing, shall be counted by the man firing the same, and if the total number of explosions is less than the number of charges fired, a report of the discrepancy shall be made as the superintendent shall direct. After a hole or round of holes has been fired and it is not certain that all the charges have exploded, no person shall return to the vicinity where such charges were placed within one hour after the attempt to explode the charge or charges.

(3) No person shall extract, or attempt to extract explosives from a misfired hole, but, when possible, a new primer shall be put in and the charge blasted again. When not possible to explode the charge with a new primer, a new hole shall be drilled, which must not be nearer to the original hole than 2 ft. and shall be pointed at such an angle as to eliminate all danger of its meeting or coming closer to the other hole than 2 ft., and such new hole shall be charged with a fresh charge of explosives and then detonated; provided, that, when the above cannot be observed, a hole nearer than 2 ft. may be drilled under the direct supervision of the superintendent or foreman.[6]

(4) Within the corporate limits of cities and towns, blasts shall be fired by the application of some form of electric current only. Any other method of firing blasts is prohibited.

(5) When electricity is used to fire shots, it shall not be permitted for any person knowingly to enter the vicinity of the place where such shots have been fired, until the cable from the source of electric energy to the blasted holes shall have been disconnected. It shall be the duty of the boss or shot-firer to see that such cables are disconnected immediately after such firing, and to examine or direct such examination of such place where shots have been fired before men are permitted to work therein.

(6) It shall be the duty of the boss or shot-firer to see that special precautions are taken against the shot-firing cables or wires coming into contact with the lighting, power, or other circuits, or with any metal pipe-lines. All portable devices for generating or supplying electricity for shot-firing shall be in charge of a boss or shot-firer. No person other than a boss or shot-firer shall connect the firing-machine or battery to the shot-firing leads, and such connection shall not be made until all other steps preparatory to the firing of a shot shall have been completed, and the men removed to a safe distance. Batteries used for shot-firing shall be provided with a suitable case in which contacts shall be made or broken, except that the binding-posts for making connections to the firing-leads may be outside.

(7) Electricity from light or power circuits shall not be used for firing shots, except where the electric connections to such light or power circuits are made within an enclosed switch-box, which shall be kept securely locked and shall be accessible only to the authorized boss or shot-firer.

(8) In order to insure the safety of surrounding property and persons, no larger charge shall be used than is necessary properly to start the object it is intended to wreck or blast, and excavating contiguous to any structure shall be so carried on as not to damage such structure. Weak walls or other supports of such structure must be shored, and the blasting or decomposed or soft rock shall be forbidden.

(9) Within congested districts of cities and towns,

[2]The addition of the sentence, 'A sharp knife or other sharp tool is recommended', was suggested.

[3]The insertion of the word 'broad-jaw' before 'crimper' was recommended.

[4]It was noted that this applies to black powder only, and not to 'upper' holes.

[5]The addition of the words 'not less than' before 'one gram' was recommended.

[6]The addition of a note of caution regarding drilling near sprung holes was recommended.

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before firing any blasts, the rock to be blasted shall be covered on the top and sides with timbers, stout metal matting, or some other serviceable material to prevent the debris from flying.

Order 1108: Protection of Operator.

(1) Every hoisting-engine, motor-hoist, and air-compressor used in building construction shall be properly covered to protect the operator from falling material, but not so as to interfere with the operator's view of the steam and water gauges.

(2) Shields or screens shall be provided to protect the operator from coming in contact with crank, connecting rod, valve-rod, steam jam cylinder, gears, or other moving parts while he is standing or sitting at his place of duty.

Order 1109: Electric Equipment.

Electric fixtures and equipment used on construction work shall be safeguarded as specified in the Electric Utilization Safety Orders.

Order 1110: Machinery.

Machinery used on construction work shall be guarded as specified in the General Safety Orders.

Order 1111: Construction-Towers.

Towers used in construction work shall rest on a solid foundation, shall be substantially built of sound materials, and thoroughly braced. They shall be anchored sufficiently to withstand shock and wind.

Order No. 1112 comprises the State law regarding elevators in buildings under construction, adopted in 1913.

Order 1113: Minimum Requirements for Builder's Cages.

(1) The car-sling frame shall be made of selected timber or structural iron of sufficient strength for rated capacity of hoist.

(2) The overhead sheave-beams shall be of sufficient size and strength to carry superimposed loads and shall be of selected Oregon pine or equal.

(3) Guide-posts shall be made of seasoned pine or equal, and shall be securely fastened, reinforced, and braced. The guide-rails shall be made of selected Oregon pine or equal, and securely bolted to guide-posts.

(4) The minimum factor of safety shall be six for all construction elevator-cables. The ultimate strength of cables shall be based on manufacturers' tables.

(5) Cables shall be secured with approved clamps or fastenings in such a way as to avoid friction over sharp edges.

(6) Landing-openings for elevators shall be protected by a movable bar or bars not less than 3 ft. nor more than 4 ft. in height, with a skirting-board not less than 6 in. at all except the working-landings.[7]

(7) Elevator-cages shall be protected from falling materials and shall have the unused sides close-boarded to a height of 3 feet 6 inches.

(8) Floor openings of elevators shall be protected by a fixed enclosure, fence, or guard on the unused sides at least 5 ft. high above the floor, to consist of not less than three boards, and a skirting-board all of which shall be of not less than 1 by 6 in. lumber, or its equivalent.

Order 1114: Partitions Between Elevators.

If one or more elevators are situated in the same shaft and one elevator is put into temporary service before the others are completed, such elevator in use shall be separated from the other elevators by a continuous partition of solid material or of wire mesh.

Order 1115: Hoisting-Signals.[8]

(1) Bell, whistle, or electric signals shall be provided on elevators, hoists, and other hoisting machines.

(2) The following signals shall be used on elevators and hoisting machines:

1. One bell or whistle to go up.
2. One bell or whistle, to stop (if in motion).
3. Two bells or whistles, to go down.
4. Three bells or whistles, to go slow.

(3) Whenever derricks are used for hoisting structural steel or other materials, the following code of signals shall be used:

1. One bell, to hoist.
2. One bell, to stop (if in motion).
3. Two bells, to lower.
4. One bell, to raise boom.
5. Two bells, to lower boom.[9]

If swing-lines are used on booms:

1. Three bells or whistles, shall be to the right.
2. Three bells or whistles, shall be to stop.
3. Four bells or whistles, shall be to the left.
4. All cords, wires, or other devices used in connection with signal systems shall be adequately protected against unauthorized operation.[10]

Order No. 1117 comprises the State law regarding scaffolding for the protection of workmen.

Order 1118: Pole-Scaffolds.

(1) Pole-scaffolds intended to be used by all trades except bricklayers, masons, structural-steel workers, and riveters shall be constructed as follows: For heights not to exceed 32 ft., the poles shall be 2 by 4 in. lumber or heavier, spaced about 4 ft. 6 in. from the wall, parallel to it and not more than 10 ft. centre to centre. The platform of the scaffold shall be supported by putlogs or ledgers made of 1 by 6 in. or 1 by 8 in. boards or heavier material, laid on edge. The scaffold shall be rigidly braced and every part thereof so secured as to prevent swaying, tipping, or collapsing of same. When resting on a sidewalk the poles of the scaffold at the bottom shall be secured to a block or sill to prevent slipping. When resting on the ground, holes 6 to 8 in. deep shall be dug to receive the foot of each pole. Whenever soft

[7]It was suggested that this paragraph might be amended so as to give greater clearness.

[8]Copies of this signal code printed on cloth will be supplied by the Commission upon request.

[9]The above signals are used with two different sounding bells.

[10]A paragraph recommending the display of these signals at prominent places on the work was suggested.

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soil is encountered, the poles shall be secured to mud-sills. The platform shall be made of planks at least 2 in. thick and shall be at least 24 in. wide, laid directly upon the putlogs or ledgers.

(2) Pole-scaffolds over 32 ft. high and not to exceed 60 ft. high shall be supported by 4 by 4 in. posts or heavier material and shall be constructed as specified in section 1.

(3) Scaffolds at a height of 20 ft. or more above the street or ground level, or a floor, except scaffolding wholly within the interior of a building and covering the entire floor space of any room therein, shall be provided along the outer edges and ends with substantial railings or enclosures of wire mesh or other suitable material to a height of at least 3 ft. 6 in. above the working-platform.

Order 1119: Bricklayers' and Masons' Pole-Scaffolds.

Bricklayers' and masons' pole-scaffolds for structures up to and including 60 ft. in height shall be supported by 4 by 4 in. posts, or heavier material, spaced not greater than 7 ft. 6 in. centre to centre. For structures exceeding 60 ft. in height, the posts shall be correspondingly increased at the bottom and gradually tapered to a minimum of 4 by 4 in. at the top. The platform shall be at least 4 ft. wide, constructed of planks at least 2 in. thick, laid closely together.[11] The platform shall be supported by putlogs or ledgers, lashed, nailed, or bolted to the posts. Putlogs or ledgers shall be made of either one 2 by 6 in. piece, securely fastened at each point of support, or two 1 by 8 in. pieces, one being on each side of the post and fastened securely at each point of support. A toe-board at least 10 in. high shall be placed on the outside edges of bricklayers' and masons' pole-scaffolds.

Pole-scaffolds shall be adequately braced and so constructed as to prevent swaying or collapsing.

Order 1120: Horse-Scaffolds.

(1) Horse-scaffolds shall be substantially constructed of sound lumber and braced internally and externally and the platform laid tight.

(2) Horses used for scaffolds shall be kept in good repair.

(3) A sufficient number of horses shall be placed under each platform to carry the imposed loads. Each horse shall rest on solid foundations.

(4) Platforms of horse-scaffolds 10 ft. or over in height shall be provided on the outside edge with a toe-board made of at least a 2 by 6 in. board set on edge.

Order 1121: Outrigger-Scaffolds.

Whenever an outrigger-scaffold is used, the cantilevers or sustaining beams shall be substantially supported and braced on the inside or outside of the structure and shall be capable of carrying the imposed loads.

Order 1122: Bricklayers' or Masons' Suspended Scaffolds.

(1) The thrust-outs supporting scaffolds shall be capable of carrying the imposed loads. These thrust-outs shall be substantially secured.

(2) The scaffold shall be suspended by steel cables of sufficient size to carry the imposed loads with a safety factor of six, and shall be securely fastened to thrust-outs by approved clamps and secured against slipping.

(3) The platform shall be at least 4 ft. wide and made of 2 in. planks adequately secured and laid tight. The putlogs or ledgers shall be at least 4 by 6 in. timber, not more than 8 ft. centre to centre.

(4) The outside of the platform shall be provided with a substantial railing of iron or wood, at least 3 ft. 6 in. high, and provided with a toe-board at least 10 in. high. When work is being done above such suspended scaffold it must be protected from falling materials.

(5) The scaffold shall be as close to the wall as possible to prevent material falling between scaffold and building-wall.

Order 1123: Tuckpointers' Suspended Scaffolds.

(1) Bales, stirrups, and slings shall be made of at least $\frac{5}{8}$-in. steel cable, composed of 6 strands of 19 wires each, or of solid round or square steel not less than $\frac{3}{4}$ in. diam., forged or welded in one piece.

(2) Beneath the platform of the scaffold there shall be an additional safety-cable securely fastened to the stirrup or bale, to hold the platform if the bolster should break.

(3) Putlogs and bolsters shall be not less than 2 in. wide and 4 in. deep, of first quality, straight-grained seasoned pine.

(4) An iron or steel bolt not less than 6 in. long and $\frac{3}{4}$ in. diam. shall be fastened through the putlog or bolster at right angles to same not nearer than 3 in. to the end and half-way between the upper and lower sides, to prevent bale or sling from slipping off the end of bolster.

(5) The platforms of all tuckpointers' suspended scaffolds shall be made of planks not less than $1\frac{1}{2}$ in. thick, and 24 in. wide, substantially secured to putlogs or bolsters to prevent same from slipping or collapsing. The falls, or hangers, shall not be more than 14 ft. apart.

Order 1124: Painters' Suspended Scaffolds.

(1) Platforms of suspended scaffolds or stagings for structures under 50 ft. in height shall be made of planks at least 14 in. wide and $1\frac{1}{2}$ in. thick, and shall be straight, sound, free from cracks, shakes and knots, of the required dimensions throughout, and securely fastened to putlogs or bolsters.

(2) For structures over 50 ft. high, the platform shall be at least 20 in. wide.

(3) All bales, stirrups and slings shall be made of standard $\frac{3}{8}$ in. wire cable, or of solid round or square steel not less than $\frac{3}{4}$ in. diam., forged or welded in one piece. Loops and stirrups for the use of bolsters shall be spliced. The supporting loop shall have a galvanized thimble fastened in place with an approved clip.

(4) An iron or steel bolt 6 in. long and $\frac{3}{4}$ in. diam. shall be fastened through the putlog or bolster at right

[11] The addition of some provision regarding the securing of the floor-planks from slipping was recommended.

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angles to same not nearer than 3 in. to the end and halfway between the upper and lower sides, to prevent bale or sling from slipping off the end of bolster.

(5) The scaffoldings or stagings shall be fastened so as to prevent them from swaying from the building or structure, and all parts of such scaffoldings or stagings shall be rigidly constructed and of sufficient strength to support loads that may be placed thereupon.

(6) The spans between falls or hangers shall be not more than 14 ft. and not more than two men shall be allowed to work between two hangers or falls.

(7) Safety-lines hanging from the roof, securely tied thereto, shall be provided between each pair of hangers or falls more than 7 ft. apart.

(8) The hooks supporting the scaffolds or stagings shall be made of high-grade wrought or Norway iron, or its equivalent, free from flaws or other imperfections. They shall be anchored to the roof or fire-wall so as to prevent them from slipping. Whenever they are secured to wood, it shall be sound and free from cracks and shakes. If the wood is found to be defective a sound plank shall be secured to the roof, to which the hooks shall be anchored and tied rigidly with ropes to solid and substantial objects on the roof.

(9) All ropes supporting scaffolds shall have a factor of safety of at least six, and shall be frequently inspected to ascertain whether they are sound and free from any acids or flaws. Whenever ropes used to support loads have come in contact with any acid, or show signs of deterioration, such ropes shall be condemned for further use.

(10) Wherever acids are to be used by painters or other trades to clean structures, the hangers or falls and slings shall be made of steel cables.

(11) Scaffolds or stagings suspended more than 20 ft. from the ground or floor, and where the falls or hangers are more than 7 ft. apart, shall have a safety-rail of wood or other equally rigid material of sufficient strength to bear any sudden strain equal to four times the weight of an ordinary man and said rail shall rise at least 34 in. above the floor or floors of such scaffoldings or stagings.

Order 1125: Riveters' Scaffolds

(1) Riveters' scaffolds shall be suspended by not less than $\frac{3}{4}$-in. manila rope, or its equivalent, and so secured to the beams or girders as to prevent same from slipping.

(2) Ropes shall be free from acids, flaws, or other imperfections.

(3) The needle-beams shall consist of not less than 4 by 4-in. lumber or 3-in. pipe, or heavier material.

(4) Each platform of the scaffold in the interior of the building shall be at least 2 ft. wide, and on the outside at least 3 ft. wide, made of planks 2 in. thick or heavier, and shall be so secured by suitable cleats or drop-bolts to prevent slipping, tipping, or collapsing.

Order No. 1126 comprises the State law regarding the protection of workmen on buildings, adopted in 1909 and amended in 1911.

Order 1127: Safety-Nets.

(1) Where it is impracticable to provide temporary floors on structures as required in these Orders, rope nets shall be suspended below points where men are working on such structures as steel-frame theatres, auditoriums, towers, and bridges.

(2) The nets shall be made of at least $\frac{1}{2}$-in. manila rope with $\frac{3}{4}$-in. borders and 4 by 4-in. mesh. The borders of the nets shall be provided with loops so that they can be readily combined or attached to convenient points on the structural frame.

Order 1128: Rivet-Heaters.

The rivet-heater shall be as near as possible to the gang or gangs with whom he is working.

Order 1129: Derricks.

No derrick shall be loaded in excess of its rated safe carrying-capacity.[12]

Order 1130: Slings.

The slings on derricks, or other hoisting-apparatus, shall be made of wire cable, chains, or manila rope of sufficient strength to carry the imposed loads.[13]

Order 1131: Floor-Openings to Be Guarded.

(1) Floor-openings within a building or other structure during the course of construction, alteration, repairing, or wrecking, shall be covered with planks so as to carry safely any load which may be required to be supported thereon, or fenced on all sides by a barrier not less than 3 ft. 6 in. high, except on those sides which may be used for the handling of materials hoisted through such openings, or at which stairs or ladders land, provided that such sides other than landings shall be guarded by portable railings not less than 3 ft. 6 in. high.

(2) If a runway or scaffold is built across a floor-opening, the entire opening shall be planked. Otherwise the runway or scaffold shall be provided with a railing at least 3 ft. 6 in. high and shall have a toe-board at least 10 in. high.

(3) Planks, railings, or barriers guarding floor-openings shall be left in place until such openings are permanently protected.

(4) Scaffolds or runways adjoining a floor-opening shall have a railing at least 3 ft. 6 in. high and a toe-board at least 10 in. high on the side next to the opening.

Order 1132: Temporary Stairs in Structures Over 60 ft. High.

In structures over 60 ft. high where it is impracticable to construct permanent stairs as the building or structure progresses, substantial temporary stairs shall be provided.

Order 1133. Life-Lines and Safety-Belts.

Whenever it becomes necessary for workmen to crawl out on thrust-outs and such other places where no other

[12]It was recommended that the safe carrying-capacity should be marked plainly on each derrick. It was also decided that spliced booms should not be prohibited.

[13]It is recommended that wherever practicable, men shall not climb up or down steel columns or ride on loads or slings.

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protection is afforded them, life-lines and safety-belts shall be provided.

Order 1134: Ladders.

(1) Substantial ladders shall be provided on buildings and other structures during the construction, alteration, repairing, or wrecking of same.

(2) The stringers and rungs of ladders shall be made of sound lumber free from cracks, shakes, and loose knots.

(3) On buildings more than two stories high and under 60 ft., double ladders shall be provided and left in place until the stairways are ready for use.

(4) Ladders shall extend at least 2½ ft. above the floor.

(5) Ladders shall be secured against displacement. The following ways are suggested:

1. By nailing a cleat on the floor in front of the ladder.
2. By nailing the feet rigidly to the floor.
3. By having the feet of the ladder shod with steel points.
4. By lashing the ladder on top.

(6) Whenever a ladder is placed over an opening the landing shall be at least 4 ft. square.[14]

Order 1135: Demolishing Buildings.

In demolishing buildings or other structures, or part thereof, material displaced shall be transported immediately to the ground. No material shall be stored upon the floor of any story under demolition.

Order 1136: Piling Material.

(1) Brick, tile, building-blocks, and similar material shall be safeguarded against falling by the use of headers at least every sixth course, and shall, when the pile is over 4 ft. 6 in. high, taper back 1 in. to each foot. Other effective measures may be substituted.

(2) In piling bags of cement or similar material more than 5 ft. high, the face of the pile shall be tapered back (except where supported by walls or otherwise), or the sacks shall be so tied in horizontal layers as to prevent them from falling or collapsing.

Order 1137: Safety-Hooks.

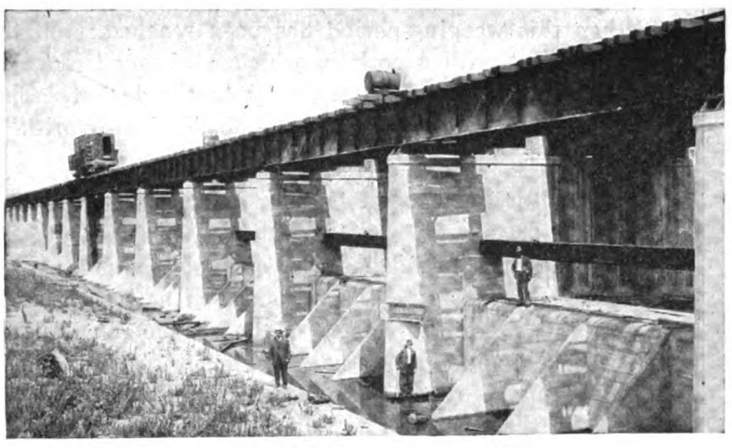
No open hook shall be used with a bucket, cage, or skip in hoisting, but some approved form of safety-hook or shackle-hook shall be used.

[14]It was suggested that provisions be added regarding the distance between ladder rungs and the wall when ladders are vertical, also regarding the spacing of rungs.

The Sacramento By-Pass and Weir

By FRANK C. MILLER*

The flood-control plan for the Sacramento river as adopted by Congress includes the construction of several weirs, designed to control the amount of flood-waters passing through by-passes provided in the general plan. The city of Sacramento voted bonds in 1912 for the construction of what was then called the Bryte by-pass and weir and is now known as the Sacramento by-pass and weir.



PART OF COMPLETED WEIR

The weir is about 3½ miles above Sacramento on the Yolo county side. It is designed to carry the flood-waters into the Yolo by-pass. The design finally adopted by the War Department will handle a maximum flow of 188,000 second-feet. Since the American river sometimes has a flood discharge of 180,000 second-feet and the channel of the Sacramento river can carry only 110,000 second-feet in front of the city, it is evident that with the American basin, the Sutter basin, and the Yolo basin reclaimed, it is necessary to provide a way for this excess water to reach the Yolo by-pass. This is to be accomplished by the Sacramento by-pass and weir.

Bids for the construction of the weir, including the necessary railroad and highway bridges, were received May 23, 1916, and the contract awarded to Teichert & Ambrose of Sacramento, the lowest bidders. The approximate quantities for some of the more important items are as follows: 100,000 cu. yd. earthwork, 16,475 cu. yd. concrete, 50,000 lin. ft. concrete piling, 48 spans, each 41 ft. 3 in. long, of a deck plate-girder railway bridge, 48 spans, each 41 ft. 3 in. long, of a concrete highway bridge.

The weir is made up of 48 spans, each 41 ft. 3 in. long, each opening being fitted with needle-beam gates, alternate openings provided with loose needles and hinged needles. The loose needles are strung on a cable attached to the pier to hold them from floating away when operating. They bear against a 6 by 8-in. timber at the bottom. This timber is bolted to an 8 by 8-in.

*City engineer, Sacramento.

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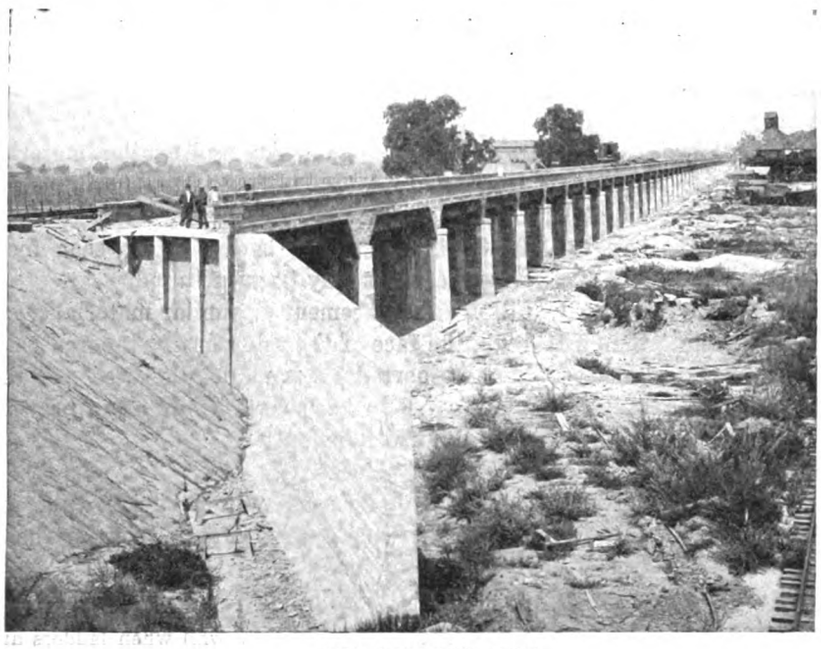
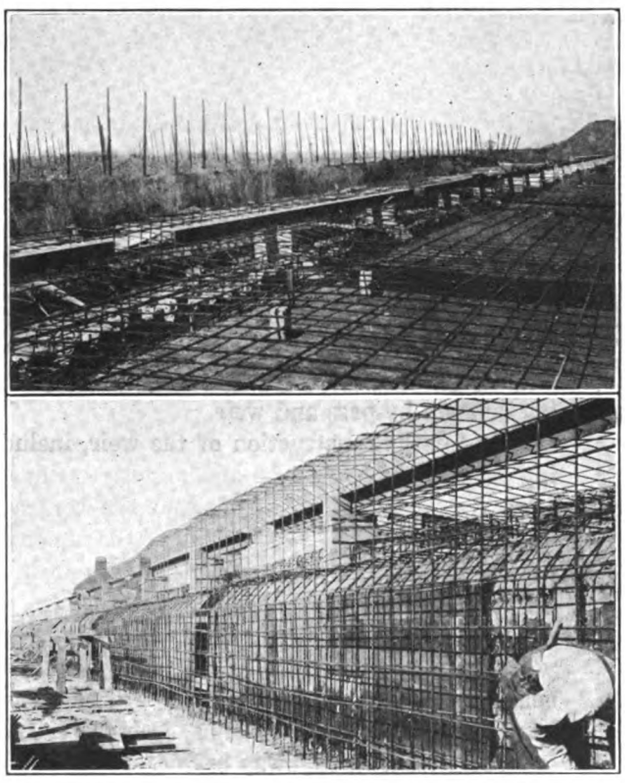
angle set in the concrete as shown in the illustrations. The hinged needles are also attached to this angle. All needles will ultimately be hinged provided it is found



THE COMPLETED WEIR

that their operation is more satisfactory than that of the loose needles. The upper ends of all the needles



VIEWS DURING CONSTRUCTION SHOWING METHOD OF PLACING REINFORCEMENT

bear against an 18 by 22 in. by 38-ft. long timber, one end of which rests in a pocket at the pier and the other on a concrete bearing on the pier. It is held in place by a trigger operated by a float in a float-chamber in each pier.

This float is set to operate the trigger so that at a given height of water certain gates open. If the water continues to rise, another set of gates will open, and so on with each additional rise of 6 in. until all the gates are released, when the maximum flood discharge of 188,000 second-feet will be carried.

A single-track interurban electric railway is carried across the weir on a steel deck-girder bridge and a highway on a reinforced concrete bridge. The contract for the weir calls for the expenditure of about $350,000, which is less than one-third of the total cost of the weir and by-pass complete. The California State Reclamation Board will complete the levees, and has recently made an assessment on the property benefited, for the entire cost of the weir and by-pass amounting to $1,095,000.

Cracks in the water-jackets of automobile engines can be filled by using liquid solution, in which advantage is taken of the property possessed by copper salts of depositing their metallic contents when in contact with iron. To fill a crack in the water-jacket, all that is necessary is to fix the cylinder vertically in a tank; plug the lower water-outlet in the jacket with a cork; then fill the jacket through the upper inlet with a sufficiently concentrated solution of sulphate of copper. This will at once commence to leak away through the crack or cracks and collect in the tank. The liquid should be returned to the water-jacket. The leakage will be quickly reduced to a slight 'weeping' at the crack. When this weeping-period has been reached, stop the upper inlet with a cork in which a bicycle-tire valve has been fitted, and pump air into the jacket. This will soon complete the repair.—'Mechanical World.'

A reinforced concrete floating dock is being built at Jutland, Denmark. A foundation of boards, 100 ft. long and 6 ft. broad, is used, on which is mounted a skeleton of 340 iron pillars, connected at the top with girders. The reinforcement of the bottom consists of a network of rods and wires. The concrete is poured in wooden molds round the pillars. The outer and inner walls of the dock will be 12.5 ft. thick, and the bottom will have the same dimensions. The sides of the dock are divided into six compartments, which can be filled with water by opening the bottom-valves. They can be emptied by power installations in a small compartment in each of the six water-tanks. The dock, when completed, will weigh about 700 tons, and will be used both for new vessels and for repairs.—'Mechanical World.'

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Recent Bids on State Highway Work—Part I

Following is a summary of bids received by the California State Highway Commission at various times from June 25 to September 4. For convenience in comparison with the bids given in an article in our July number, the same reference-numbers have been assigned to the contractors, as follows:

(1) Bechtel, Quayle & Fontaine, San Francisco.
(3) C. H. & A. W. Gorrill, San Francisco.
(4) Palmer & McBryde, San Francisco.
(5) Tieslau Bros., San Francisco.
(6) Whitlock & Gorrill, Berkeley.
(7) Bates, Borland & Ayer, Oakland.
(8) P. H. Hoare, Oakland.
(11) George S. Benson & Sons, Los Angeles.
(12) Conner Contracting Co., Los Angeles.
(13) L. G. Garnsey, Los Angeles.
(18) M. T. Shafer, Los Angeles.
(19) Robert Sherer, Los Angeles.
(20) Tryon & Brain, Los Angeles.
(21) James Fitzpatrick, Sacramento.
(26) Brashear-Burns Co., Los Angeles.
(32) W. A. Bechtel, San Francisco.
(33) Flinn & Treacy, San Francisco.
(34) J. P. Holland, San Francisco.
(35) L. S. Atkinson, Jr., Los Angeles.
(36) T. E. Shafer, Los Angeles.
(37) A. L. McCray, Los Angeles.
(38) Richard Rothwell, Los Angeles.
(39) W. M. Ledbetter, Los Angeles.
(40) C. D. Tompkins, Los Angeles.
(41) A. Teichert & Son, Sacramento.
(42) Holland Construction Co., San Diego.
(43) C. L. Hyde Construction Co., San Diego.
(44) Municipal Improvement Co., Richmond.
(45) Johnson-Shea Co., Oakland.
(46) Worswick Construction Co., Vallejo.
(47) A. Robinson and R. R. Smith, Fortuna.
(48) J. A. Marshall, Berkeley.
(49) A. J. Fairbanks, Willits.
(50) F. Rolandi, San Francisco.
(31) Engineers' Estimate.

The following bids were received June 25 for construction of 10.8 miles of highway between Blacks and Hershey in Yolo county:

Item and quantity	(31)	(3)	(41)	(4)
Excavation, 30,800 cu. yd.	$0.60	$0.80	$0.65	$0.75
12-in. pipe, 180 ft.	0.50	0.50	1.00	0.60
18-in. pipe, 300 ft.	0.60	0.70	1.50	0.70
24-in. pipe, 120 ft.	0.80	0.80	2.00	0.80
Concrete in culverts and monuments, 350 cu. yd.	10.00	12.50	14.00	15.00
Concrete in pavement, 10,550 cu. yd.	3.25	3.80	4.40	4.00
Wire-mesh reinforcement, 303,000 sq. ft.	0.001	0.0025	0.006	0.003
Guard-rail, 1700 ft.	0.40	0.45	0.40	0.50
Monuments, 86	0.50	1.50	1.50	1.00
Total	$66,308.43	$71,152.50	$74,837.00	$72,809.00

The State furnishes pipe-railing, reinforcing steel, corrugated-metal pipe, wire-mesh reinforcement, cement, sand, and coarse aggregate, valued at $66,251.10. Contract was awarded to C. H. & A. W. Gorrill for $71,152.50, making a total cost of $137,403.60, or $12,720 per mile. The cost of excavation alone was $24,640 or $2300 per mile.

The following bids were received June 25 for the construction of 3.7 miles of highway between Altamount and Greenville in Alameda county:

Item and quantity	(31)	(3)	(4)	(8)	(7)	(34)
Excavation, 52,000 cu. yd.	$0.60	$0.90	$0.655	$0.90	$0.66	$0.75
12-in. pipe, 700 ft.	0.50	1.00	0.60	0.40	0.75	0.75
15-in. pipe, 200 ft.	0.60	1.00	0.70	0.50	0.75	0.80
18-in. pipe, 190 ft.	0.70	1.25	0.80	0.80	0.75	0.80
24-in. pipe, 56 ft.	0.90	1.50	1.00	1.00	0.75	1.00
30-in. pipe, 28 ft.	1.25	2.00	1.50	1.00	0.75	1.10
Concrete in culverts and monuments, 200 cu. yd.	10.00	15.00	13.00	10.00	12.50	11.00
Concrete in pavement, 3500 cu. yd.	3.75	4.90	4.00	3.95	3.80	3.85
Wire-mesh reinforcement, 90,000 sq. ft.	0.001	0.003	0.002	0.01	0.01	0.00175
Guard-rail, 8000 ft.	0.35	0.50	0.50	0.40	0.35	0.50
Monuments, 116	1.00	1.50	1.00	1.50	1.00	1.25
Total	$57,522.31	$72,671.50	$55,506.00	$67,515.00	$54,816.50	$59,901.30

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The State furnishes reinforcing-steel, cement, sand, gravel, corrugated pipe, and wire-mesh reinforcement, valued at $24,110. Contract was awarded to Bates, Borland & Ayer for $54,816.50, making a total cost of $78,926.50, or $21,330 per mile. The cost of excavation alone was $9300 per mile.

The following bids were received June 25 for the construction of 8.6 miles of highway in Napa county between Napa and the easterly county boundary:

Item and quantity	(31)	(46)	(5)
Excavation, 40,000 cu. yd.....	$0.75	$1.05	$0.90
12-in. pipe, 100 ft.....	0.50	0.45	0.60
15-in. pipe, 270 ft.....	0.60	0.55	0.75
18-in. pipe, 440 ft.....	0.70	0.67	0.90
24-in. pipe, 210 ft.....	0.90	0.80	1.00
30-in. pipe, 36 ft.....	1.25	1.00	1.25
Concrete in culverts and monuments, 320 cu. yd.....	10.00	9.62	12.50
Concrete in pavement, 10,300 cu. yd.	4.00	4.43	5.40
Wire-mesh reinforcement, 152,000 sq. ft.....	0.001	0.005	0.003
Tile-drain, 4-in., 200 ft.....	0.05	0.18	0.30
Monuments, 105	0.50	2.30	2.00
Total	$86,673.78	$92,437.20	$97,259.50

The State furnishes pipe-railing, reinforcing-steel, wire-mesh reinforcement, corrugated pipe, cement, sand, coarse aggregate, drain-tile, and broken stone, valued at $72,016. Contract was awarded to the Worswick Construction Co. for $92,437.20, making a total cost of $164,453.20, or $19,120 per mile.

The following bids were received June 25 for construction of 11 miles of highway in Monterey county between Camphora and Chualar:

Item and quantity	(31)	(4)	(5)
Excavation, 22,000 cu. yd.....	$0.45	$0.80	$0.75
12-in. pipe, 1120 ft.....	0.50	0.60	0.60
18-in. pipe, 160 ft.....	0.60	0.70	0.90
24-in. pipe, 200 ft.....	0.70	0.80	1.25
Concrete in culverts and monuments, 45 cu. yd.....	10.00	15.00	12.50
Concrete in pavement, 10,710 cu. yd.	3.80	4.00	5.40
Guard-rail, 1000 ft.....	0.40	0.50	0.50
Monuments, 66	0.50	1.00	2.00
Total	$60,118.55	$62,625.00	$76,594.50

The State will furnish corrugated pipe, pipe-railing, reinforcing-steel, cement, sand, and coarse aggregate, valued at $61,092.68. Contract was awarded to Palmer & McBryde, for $62,625, making a total of $123,717.68, or $11,250 per mile.

The following bids were received June 25 for construction of 6.4 miles of highway in Tulare county between Pixley and Tipton:

Item and quantity	(31)	(35)	(11)	(36)	(45)	(13)
Excavation, 13,500 cu. yd.....	$0.52	$0.60	$0.65	$0.77	$0.75	$0.70
Property fences, 12,000 ft.....	0.02	0.10	0.08	0.06	0.075	0.12
12-in. pipe, 600 ft.....	0.50	0.50	1.00	0.75	1.00	1.00
24-in. pipe, 250 ft.....	0.60	0.60	1.00	1.00	1.00	1.25
Concrete in culverts and monuments, 30 cu. yd....	10.00	15.00	15.00	14.00	15.00	15.00
Concrete in pavement, 6300 cu. yd.....	3.25	4.60	3.90	4.00	4.30	3.59
Guard-rail, 96 ft.....	0.35	0.80	0.80	0.60	1.00	0.75
Monuments, 39	0.50	2.00	2.00	0.50	2.50	1.00
Total	$32,818.81	$39,309.80	$35,759.80	$37,512.10	$39,608.50	$34,980.50

The State furnishes pipe-railing, reinforcing-steel, corrugated metal pipe, cement, sand, and coarse aggregate, valued at $38,221.50. Contract was awarded to L. G. Garnsey for $34,980.50, making a total cost of $73,202, or $11,440 per mile.

The following bids were received June 25 for construction of 8.9 miles of highway in Tulare county between Tipton and Tulare:

Item and quantity	(31)	(13)	(36)	(45)	(18)	(35)
Excavation, 44,800 cu. yd.....	$0.50	$0.70	$0.62	$0.70	$0.70	$0.60
12-in. pipe, 60 ft.....	0.50	1.00	0.75	1.00	1.00	1.00
24-in. pipe, 270 ft.....	0.60	1.25	1.00	1.00	1.00	1.00
30-in. pipe, 30 ft.....	1.00	1.25	1.50	1.50	1.00	1.00
Concrete in culverts and monuments, 470 cu. yd...	10.00	15.00	14.00	15.00	13.00	15.00
Concrete in pavement, 8745 cu. yd.....	3.25	3.81	3.92	4.10	4.10	4.60
Guard-rail, 850 ft.....	0.40	0.75	0.60	0.70	1.00	0.80
Monuments, 55	0.50	1.00	0.50	2.50	1.50	2.00
Total	$64,527.36	$72,855.95	$69,533.90	$75,372.00	$74,617.00	$75,307.00

The State furnishes steel reinforcement, cement, sand, broken stone, and corrugated pipe, valued at $51,880. Contract was awarded to T. E. Shafer for $69,533.90, making a total cost of $121,413.90, or $13,640 per mile.

The following bids were received July 16 for construction of 10.6 miles of State highway in Los Angeles county between Seeley's ranch and a point near the town of Acton:

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Item and quantity	(31)	(37)	(38)	(20)
Excavation, 50,000 cu. yd	$0.30	$0.45	$0.50	$0.35
18-in. pipe, 295 ft	0.50	1.00	0.90	1.50
24-in. pipe, 377 ft	0.75	1.50	1.50	1.75
Concrete in culverts and monuments, 130 cu. yd	13.50	15.00	16.00	15.00
Concrete in pavement, 13,820 cu. yd	5.00	8.75	8.50	6.72
Guard-rail, 7000 ft	0.40	0.50	0.45	0.55
Monuments, 146	0.50	1.00	1.50	1.50
Total	$102,531.99	$149,881.50	$148,750.00	$117,491.65

All bids were rejected because too high. Bids for this work had been received once before, Tryon & Brain being the only bidders at $123,836.45 or $6000 more than their later bid.

The following bids were received July 16 for construction of 8.7 miles of State highway in Los Angeles county between a point near Acton and Palmdale:

Item and quantity	(31)	(38)	(37)
Excavation, 66,100 cu. yd	0.40	0.60	0.50
18-in. pipe, 1195 ft	0.50	0.90	1.00
24-in. pipe, 319 ft	0.75	1.50	1.50
Concrete in culverts and monuments, 290 cu. yd	13.50	16.00	15.00
Concrete in pavement, 11,300 cu. yd	5.00	8.40	9.00
Guard-rail, 7000 ft	0.45	0.45	0.50
Monuments, 153	0.50	1.50	1.00
Total	$104,555.99	$144,153.50	$144,426.50

All bids were rejected because too high. The State was to have furnished steel, cement, and corrugated pipe, valued at $50,829.

The following bids were received August 6 for construction of 9.3 miles of highway between El Capitan creek and Alcatraz in Santa Barbara county. Rough grading had been done before.

Item and quantity	(31)	(40)	(33)	(20)	(35)
Excavation, 7700 cu. yd	$0.55	$0.98	$0.85	$0.45	$1.00
Concrete in pavement, 9040 cu. yd	3.50	4.1499	4.15	3.82	6.04
Wire-mesh reinforcement, 90,000 sq. ft	0.001	0.0025	0.005	0.007	0.004
Rubble drain, 30 cu. yd	2.25	5.00	10.00	6.50	5.00
Total	$41,437.38	$45,436.10	$44,811.00	$38,822.80	$62,811.60

The State furnishes wire-mesh reinforcement, cement, sand, and coarse aggregate, valued at $64,145. Contract was awarded to Tryon & Brain for $38,822.80, or a total of $102,967.80, or $11,070 per mile.

The following bids were received August 6 for construction of 7.7 miles of highway between Elwood and El Capitan creek in Santa Barbara county. Rough grading had been done before.

Item and quantity	(31)	(31)	(12)	(20)	(33)	(40)
Excavation, 8450 cu. yd	$0.55	$0.95	$0.90	$0.45	$0.85	$1.10
Concrete in pavement, 7540 cu. yd	3.50	6.39	3.90	3.82	4.15	4.40
Wire-mesh reinforcement, 30,000 sq. ft	0.001	0.004	0.002	0.007	0.005	0.0025
Rubble drains, 125 cu. yd	2.25	5.00	7.50	6.50	40.00	5.00
Total	$36,051.06	$56,953.10	$38,008.50	$33,627.80	$43,623.50	$43,171.00

The State furnishes cement, sand, broken stone, and wire-mesh reinforcement, valued at $51,880. Contract was awarded to Tryon & Brain, for $33,627.80, or a total of $85,507.80, or $11,100 per mile.

The following bids were received August 20 for construction of 13.3 miles of highway between the Sacramento river and Lamoine in Shasta county. Paving is not to be done at this time.

Item and quantity	(31)	(38)	(4)	(19)	(1)	(21)	(44)	(50)
Excavation, 151,000 cu. yd	$0.70	$1.00	$0.80	$0.77	$0.91	$0.75	$1.14	$0.82
12-in. pipe, 2000 ft	0.60	0.60	0.80	0.50	0.70	0.65	1.00	0.60
18-in. pipe, 1700 ft	0.75	0.75	0.90	0.50	0.85	0.90	1.25	0.80
24-in. pipe, 900 ft	0.90	0.90	1.00	0.50	1.00	1.15	1.50	1.00
Concrete in culverts and monuments, 1500 cu. yd	15.00	16.00	17.50	18.75	17.00	16.00	15.00	16.00
Concrete in retaining-walls, 100 cu. yd	10.00	16.00	17.50	16.00	15.50	12.00	12.00	15.00
Ruble masonry, 750 cu. yd	6.00	8.00	10.00	10.00	8.00	7.00	10.00	5.00
Dry-rubble mansonry, 300 cu. yd.	5.00	6.00	8.00	4.50	6.00	5.00	6.00	4.00
New property fences, 1.5 miles	175.00	200.00	175.00	250.00	210.00	200.00	2,250.00	300.00
Moving and re-setting property fences, 1.5 miles	175.00	200.00	200.00	300.00	280.00	200.00	2,500.00	300.00
Slope-paving, 200 cu. yd	3.50	4.00	10.00	6.00	6.00	14.00	8.00	3.00
Monuments, 610	1.00	1.00	1.00	1.50	1.25	1.00	1.00	1.50
Total	$161,368.00	$189,695.00	$165,902.50	$160,085.00	$178,702.50	$153,075.00	$219,950.00	$160,145.00

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The State will furnish pipe-railing, reinforcing-steel, cement, corrugated pipe, and fencing-materials, valued at $17,599.30. Contract was awarded to J. F. Fitzpatrick for $153,075, or a total of $170,674.30, or $12,830 per mile.

Bids were received August 27 for construction of 3.8 miles of highway in Los Angeles county between Kay ranch and Castaic school. Brashear-Burns Co. was the only bidder and was awarded the contract. The company's bid was $0.90 per cu. yd. for excavation, and $8.60 per cu. yd. for concrete in pavement, a total of $48,930. The engineer's estimate on these items was $0.60 and $6.50, giving a total after the customary 15% had been added, of $41,745. The contractor's bid was about 17% higher than the estimate. The State furnishes cement valued at $17,745.20, or a total cost of $66,775.20, or $17,570 per mile.

On the same date the Municipal Improvement Co. was the only bidder for construction of 7 miles of highway in Contra Costa county between Eckley and Martinez, at $1.10 per cu. yd. for excavation, and $7.50 per cu. yd. for concrete in pavement, a total of $64,230. The engineers' estimate was $0.55 and $4.50, a total of $43,142.25, after the 15% allowance had been added. The State was to have furnished cement, sand, and coarse aggregate, valued at $35,562. The bid was rejected and the work is being done by day-labor.

The following bids were received August 27 for construction of 5.7 miles of state highway between Hercules and Eckley in Contra Costa county:

Item and quantity	(31)	(44)	(5)	(6)
Excavation, 17,000 cu. yd	$0.55	$0.90	$1.25	$0.60
12-in. pipe, 300 ft	0.50	0.60	0.50	0.60
15-in. pipe, 60 ft	0.60	0.70	0.70	0.80
18-in. pipe, 140 ft	0.70	0.80	0.85	1.00
Concrete in culverts and monuments, 220 cu. yd	10.00	13.50	15.00	12.00
Concrete in pavement, 5680 cu. yd	4.20	5.80	6.62	5.75
Concrete in retaining-walls, 1350 cu. yd	5.00	9.95	9.00	8.00
Monuments, 33	0.50	1.00	2.00	2.00
Total	$48,824.98	$65,013.50	$74,678.60	$56,734.00

The State furnishes pipe-railing, reinforcing-steel, corrugated pipe, cement, sand, and coarse aggregate, valued at $36,436.50. Contract was awarded to Whitlock & Gorrill for $56,734, or a total of $93,170.50, or $16,350 per mile.

The following bids were received September 4 for construction of 10.8 miles of state highway between Redding and Bayha in Shasta county:

Item and quantity	(31)	(4)	(38)	(5)
Excavation, 57,000 cu. yd	$0.55	$0.80	$1.25	$0.83
12-in. pipe, 2200 ft	0.60	0.90	1.00	0.60
18-in. pipe, 1000 ft	0.75	1.00	1.25	0.80
24-in. pipe, 350 ft	0.90	1.10	1.50	1.00
Concrete in culverts and monuments, 460 cu. yd	14.00	17.50	24.00	19.50
Concrete in slope-paving, 40 cu. yd	10.00	8.00	20.00	8.00
New property fences, 8 miles	175.00	200.00	300.00	200.00
Moving and re-setting property fences, 2 miles	175.00	225.00	500.00	200.00
Monuments, 156	1.00	1.00	2.00	1.50
Total	$48,853.15	$59,541.00	$90,777.00	$61,304.00

The State furnishes pipe-railing, reinforcing-steel, wire-mesh reinforcement, corrugated pipe, cement, and material for new fences, valued at $9338.50. Contract was awarded to Palmer & McBryde for $59,541, or a total of $68,879.50, or $6880 per mile.

Lignite produced in Texas amounts to 10,000,000 tons per year, valued at about $1 per ton. The fuel situation has recently led to an investigation of the possibilities of burning this low-grade fuel in a central power-plant for generating electricity and at the same time recovering by-products such as tar and tar-oils, sulphate of ammonia, and the solid residue for making briquettes. Two methods have been suggested—to distill in retorts or to burn in gas-producers, using the gas to generate electricity. It is said that when all the energy and by-products of lignite are utilized, the South-West will not only have cheapened its fuel and power but will have gone a long way toward solving some of its industrial problems.—'Refrigeration.'

The first sea-going concrete ship, built by Fougners Steel-Concrete Shipbuilding Co. of Moss, Norway, was recently tested. The trials, extending over five hours, took place in stormy weather, with a heavy sea running. The vibration from the engine was less than in similar vessels of iron or steel. The ship is propelled by a Bolinder motor, capable of giving a speed of 7½ knots. The dimensions are: Length, 84 ft.; breadth, 20 ft.; and depth, 11½ ft. The firm has several vessels of about 1000 tons and less under construction, as well as a floating dock and a lightship for the Christiania Fjord. A large ship for the Sydvaranger Mining Co. is intended for carrying ore.—'Mechanical World.'

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Economical Proportions for Portland Cement Mortars and Concretes*

By J. A. KITTS †

The Void Theory. As an initial step in the determination of the laws of concrete mixtures, it is more important that one combination of materials be studied thoroughly in a great number of progressive proportions with enough test-specimens of each mixture properly to reduce the errors of the average results, than it is to study many combinations of a large number of materials with only a few mixtures and a few test-specimens of each combination.

With a certain combination of cement, sand, and rock, we find that an arbitrary 1:2:4 mixture shows greater strength in proportion to cost than a 1:3:6 mixture, and that a 1:2½:6 mixture is more efficient than either. It is probable that no one of these arbitrary mixtures is the most efficient and it is apparent that any number of arbitrary mixtures may be made and tested with the common result of producing more confusion than knowledge of the laws of mixtures. The arbitrary method of proportioning has been barren of positive results. Some other methods must be used if we are to obtain accurate knowledge of the laws governing mixtures.

The void theory of proportioning has been known for a number of years, but has not been given proper consideration, and the fundamental principle has not been appreciated. This lack of consideration has been because the theory, as generally known, defined the proportions for maximum strength rather than for maximum efficiency or maximum strength in proportion to cost. A broad statement of the void theory is as follows:

The proportion for maximum efficiency of a mortar or a concrete is controlled largely by the proportions of voids in the respective aggregates.

This aspect of the void theory is the basis of the following considerations.

Mortars. A mortar is a mixture of sand, cement, and water in various proportions. The question of scientific interest is: What determines the proportions for maximum efficiency?

Sands vary in physical, chemical, and mechanical structure, causing a variation in the specific gravity and percentage of voids, and the last two properties cause a variation in the weight per cubic foot or aggregate specific gravity. An important consideration in the study of a large number of mortars from a large number of aggregates is that of comparison. A study of the characteristics of various sands will show that mortars are not comparable either in arbitrary weight-proportions or in arbitrary volumetric proportions. What then determines the conditions for comparison of the mortar from one sand with that from another? An analysis of the results indicated in M. O. Withey's test

TABLES I AND II. PROPERTIES AND SIEVE-ANALYSIS OF SANDS IN WITHEY'S TESTS

Sand No.	Weight per Cubic Foot, lb.	Specific Gravity.	Voids, per cent.	Silt, per cent.	Absorption, per cent.
Standard	104.1	2.65	37.0	...	....
Sd. 1	105.2	2.66	36.5	3.0	0.19
Sd. 2	106.9	2.74	35.2	1.3	0.49
Sd. 3	101.8	2.68	38.2	0.8	0.27
Sd. 4	98.9	2.63	39.8	1.2	0.04
Sd. 5	91.2	2.67	45.3	0.5	0.17
Sd. 7	105.2	2.78	36.6	1.6	0.41
Sd. 8	105.3	2.70	36.4	1.5	0.18
Sd. 9	105.5	2.75	36.0	0.7	0.51
Sd. 10	120.3	2.77	27.9	7.7	0.29
Sd. 11	108.7	2.72	35.0	0.4	0.11

Sand No.	Percentage by Weight Passing Sieves Nos.							Uniformity Coefficient.
	10	20	30	40	50	74	100	
Standard	100.0	100.0	0.0	....	....	...	...	...
Sd. 1	86.4	65.5	39.0	25.0	9.1	5.4	2.8	3.0
Sd. 2	81.2	70.9	61.4	52.4	34.5	17.9	9.7	2.6
Sd. 3	91.9	72.7	39.7	26.4	13.7	4.2	1.2	2.4
Sd. 4	100.0	99.5	95.8	88.8	62.5	22.1	8.6	1.8
Sd. 5	100.0	99.9	99.8	99.1	67.6	18.2	5.7	1.8
Sd. 7	67.7	44.5	25.9	17.8	11.2	3.8	2.2	4.7
Sd. 8	82.0	72.5	55.3	38.6	16.1	3.6	1.9	2.6
Sd. 9	66.8	22.7	13.9	10.3	4.9	2.4	1.4	3.7
Sd. 10	69.7	48.8	34.0	26.3	17.4	8.7	6.5	6.9
Sd. 11	73.0	47.7	23.8	12.0	4.3	0.7	0.5	3.4

TABLE III. VOLUMETRIC PROPORTIONS FOR SIMPLE WEIGHT PROPORTIONS

Sand No.	Weight Proportions.			
	1:2	1:3	1:4	1:5
Sd. 10	1:1.77	1:2.65	1:3.54	1:4.42
Sd. 2	1:1.98	1:2.97	1:3.96	1:4.94
Sd. 11	1:1.99	1:2.98	1:3.97	1:4.97
Sd. 7	1:2	1:3	1:4	1:5
Sd. 9	1:2	1:3	1:4	1:5
Sd. 8	1:2.05	1:3.07	1:4.10	1:5.12
Sd. 1	1:2.08	1:3.12	1:4.17	1:5.20
Standard	1:2.11	1:3.17	1:4.23	1:5.27
Sd. 3	1:2.13	1:3.20	1:4.27	1:5.33
Sd. 4	1:2.23	1:3.34	1:4.46	1:5.57
Sd. 5	1:2.41	1:3.62	1:4.83	1:6.03

*Paper presented at the annual meeting of the American Society for Testing Materials.

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of mortars[1] throws considerable light on the two preceding questions. In these tests mortars were made in 1:2, 1:3, 1:4, and 1:5 weight proportions and the following tests made: Unit tensile strength; unit compressive strength; leakage of water through specimens 2 in. thick, with pressures of 10 and 40 lb. per sq. in.; density; yield; and compressive strength in proportion to cost. Tables I and II show the physical and mechanical characteristics of eleven of the sands used in these tests.

TABLE IV. RATIO OF VOLUME OF CEMENT PASTE TO VOLUME OF VOIDS IN SAND FOR SIMPLE WEIGHT-PROPORTIONS

Sand No.	Weight Proportions.			
	1:2	1:3	1:4	1:5
Sd. 10	2.03	1.35	1.01	0.81
Sd. 11	1.44	0.96	0.72	0.58
Sd. 2	1.43	0.96	0.72	0.57
Sd. 9	1.39	0.93	0.70	0.56
Sd. 7	1.37	0.91	0.68	0.55
Sd. 8	1.34	0.90	0.67	0.54
Sd. 1	1.32	0.87	0.66	0.53
Standard	1.28	0.85	0.64	0.51
Sd. 3	1.23	0.82	0.61	0.49
Sd. 4	1.13	0.75	0.56	0.45
Sd. 5	0.91	0.61	0.46	0.37

Tables III and IV show the variations of the volumetric and void conditions common to simple weight-proportioning.

Table III is computed by the following equation:

$$\frac{\text{Aggregate volume sand}}{\text{Aggregate volume cement}} = \frac{\text{Weight proportion sand}}{\text{Weight proportion cement}} \times \frac{\text{Aggregate specific gravity cement}}{\text{Aggregate specific gravity sand}} \quad (1)$$

$$\text{Aggregate specific gravity}^2 = (1 - \text{proportion of voids}) \times \text{specific gravity} \quad (2)$$

$$= \frac{\text{Weight, in lb. per cu. ft.}}{62.5}$$

$$= 110/62.5 = 1.76 \text{ for cement}^3$$

Table IV is computed by the following equation:

$$\frac{\text{Volume of cement-paste}}{\text{Volume of voids in sand}} = \frac{\text{Aggregate specific gravity of sand}}{\text{Aggregate specific gravity of cement} \times \text{weight proportion of sand} \times \text{voids in sand}} \quad (3)$$

$$\frac{\text{Volume of cement-paste}}{\text{Volume of voids in sand}} = \frac{1}{\text{Volume proportion of sand} \times \text{proportion of voids in sand}} \quad (4)$$

Table III shows that the volumetric proportions correspond to the 1:2 weight proportions vary from 1:1.77 to 1:2.41, the 1:3 weight from 1:2.65 to 1:3.62 volume, 1:4 weight from 1:3.54 to 1:4.82 volume, and the 1:5 from 1. 4.42 to 1:6.03. Table IV shows the proportions of voids in the sands filled with cement-paste varying from 0.91 to 2.03 for the 1:2 weight proportion, from 0.61 to 1.35 for the 1:3, from 0.46 to 1.01 for the 1:4, and from 0.37 to 0.81 for the 1:5 proportion. Nothing could better illustrate the fallacy of the practice of comparing work-sands with standard sand in 1:3 weight proportions.

Neither is there a basis of comparison in a fixed volumetric proportion. In 1:3 volumetric proportions the proportions of the voids in the sands filled with cement-paste would vary from 0.73 to 1.20 for the eleven sands as shown in Table V. It must be admitted, from both scientific and from practical considerations of a mortar, that an important function of the cement is to fill the voids in the sand; and it cannot be expected that a mortar in which the volume of cement-paste is equal to only 73% of the volume of voids in the sand, is comparable with one where the cement-paste is equal to 120% of the voids.

TABLE V. RATIO OF VOLUME OF CEMENT PASTE TO VOLUME OF VOIDS IN SAND, FOR VOLUMETRIC PROPORTIONING

Sand No.	Volumetric Proportions.			
	1:2	1:3	1:4	1:5
Sd. 5	1.10	0.73	0.55	0.44
Sd. 4	1.25	0.84	0.63	0.50
Sd. 3	1.31	0.87	0.65	0.51
Standard	1.35	0.90	0.68	0.54
Sd. 7	1.35	0.91	0.68	0.55
Sd. 1	1.36	0.91	0.68	0.55
Sd. 8	1.37	0.92	0.69	0.56
Sd. 9	1.39	0.93	0.69	0.56
Sd. 2	1.42	0.95	0.71	0.57
Sd. 11	1.43	0.95	0.71	0.57
Sd. 10	1.79	1.20	0.90	0.72

Assume, for example, that six mortars of a certain sand and cement are made in which the ratio of the volume of cement-paste to the volume of voids in the sand has, respectively, the values 0.50, 0.75, 1.00, 1.50, 2.00, and 3.00. It is reasonable to anticipate that the strength of the mortars will increase at a rapid rate until the voids in the sand are filled with cement-paste, after which the strength will increase at a lesser rate until the sand-particles are so widely separated by the cement-paste that the strength of the mortar will approximate closely the strength of the neat cement. In other words, as the cement-content is increased, the rate of increase of strength is greater before the voids are filled than it is after the voids are filled. Also in some finite proportions the strength of the mortar approximates the strength of the neat cement. Fig. 1, which shows the compressive and tensile strengths and the strength in proportion to cost for sand No. 10, plotted against the void-filled ratio, illustrates these assumptions very well. This sand, unfortunately, is the only one of this series of tests which had one mixture (the 1:4 by weight) where the volume of cement-

[1] M. O. Withey, 'Tests of Mortars Made from Wisconsin Aggregates,' Proceedings, American Society for Testing Materials.

[2] In an article on this subject published in WESTERN ENGINEERING for August 1915, I called this "apparent specific gravity," for want of a better term.

[3] 110 lb. of cement makes 1 cu. ft. or normal-consistence paste

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paste was approximately equal to the volume of voids in the sand, and which had more than one mixture where the volume of cement-paste was greater than the volume of voids in the sand.

Fig. 2 shows the compressive strengths plotted

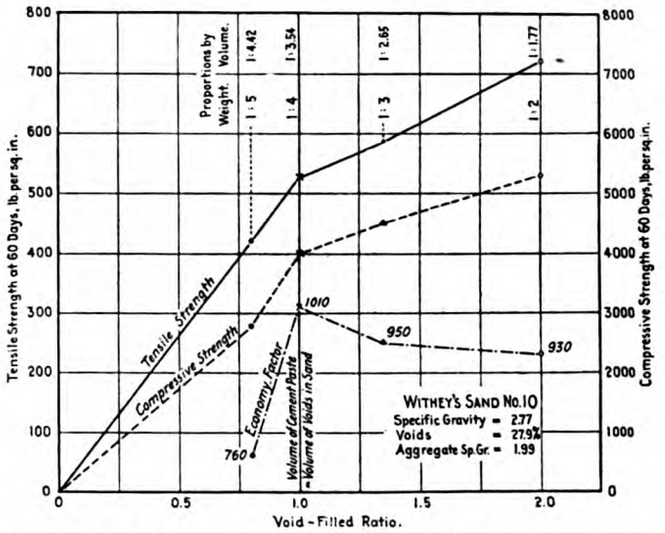

FIG. 1. VARIATIONS IN STRENGTH OF MORTAR FROM SAND NO. 10 IN PROPORTION TO VOID-FILLED RATIOS

against the void-filled ratio. The curve of averages supports the assumption as to the rate of increase of strength. The curve is fairly uniform, and would ap-

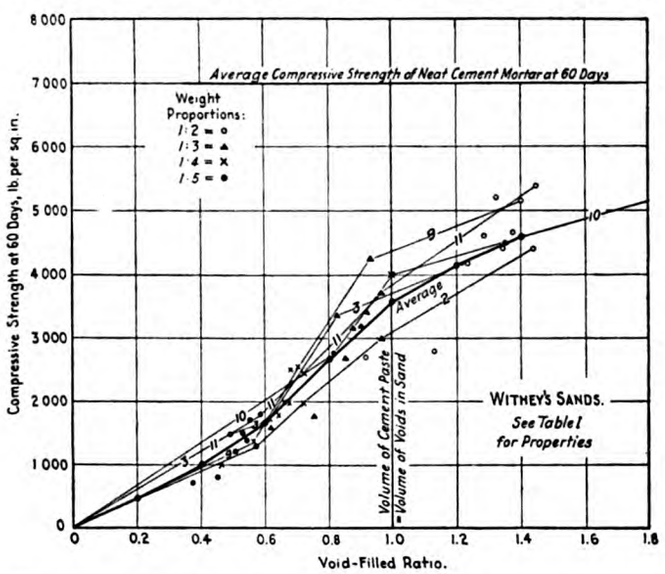
Average Compressive Strength of Neat Cement Mortar at 60 Days
Weight Proportions:
1:2 = o
1:3 = ▲
1:4 = ×
1:5 = ●
Compressive Strength at 60 Days, lb. per sq. in.
Average
WITHEY'S SANDS.
See Table I for Properties
Volume of Cement Paste = Volume of Voids in Sand
Void-Filled Ratio.

FIG. 2. VARIATION IN STRENGTH OF MORTARS IN PROPORTION TO VOID-FILLED RATIOS

pear to indicate that the void-filled ratio has a similar effect on all the sands. This, then, appears to establish the principle that the properties, strength, efficiency, etc., of mortars, are properly comparable on the basis of the void-filled ratio.

The final and most important consideration of a mortar is the strength in proportion to the cost. This may be expressed as an 'economy factor,' equal to the compressive strength in pounds per square inch divided by the cost of the mortar in dollars per cubic yard. This factor may be expressed by the following equation:

$$\text{Economy factor} = \frac{\text{Compressive strength (lb. per sq. in.)}}{\text{Cost of mortar (dollars per cu. yd.)}} = \frac{\text{Compressive strength} \times \text{yield}}{C_s + \frac{P_c \times C_c}{P_s}} \qquad (5)$$

in which P_c and P_s are the volumetric proportions of cement and sand, C_c and C_s are the costs, in dollars per cubic yard, of cement and sand, and the yield is based on the volume of the sand as unity.

This factor is plotted in Fig. 10 of Withey's paper,

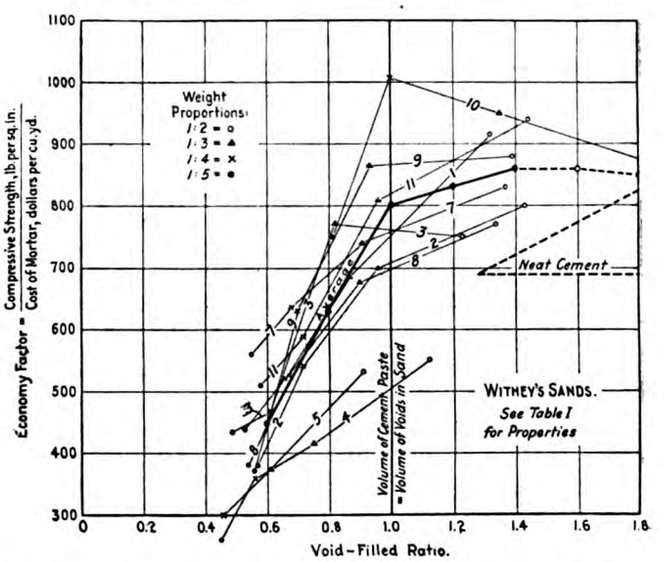
Economy Factor = Compressive Strength, lb. per sq. in. / Cost of Mortar, dollars per cu. yd.
Weight Proportions:
1:2 = o
1:3 = ▲
1:4 = ×
1:5 = ●
Neat Cement
WITHEY'S SANDS.
See Table I for Properties
Volume of Cement Paste = Volume of Voids in Sand
Void-Filled Ratio.

FIG. 3. VARIATION IN ECONOMY FACTOR IN PROPORTION TO VOID-FILLED RATIOS

mentioned above. The cost represents costs of materials only, cement being estimated at $1.50 per barrel and sand at $1.25 per cubic yard. In Fig. 3 these factors for all eleven sands have been plotted against the void-filled ratio. The average compressive strength of the cement used in these tests was less than 7000 lb. per sq. in. at 60 days. The economy factor for the neat cement mortar would then be approximately $7000 \div 10.14 = 690$.[4] The highest economy factor shown on the curve of averages is 860. This and the curve of averages indicate that the economy factor decreases when the void-filled ratio is somewhat in excess of 1.5. The results of these tests, therefore, indicate that the most economical mixtures lie between proportions giving a void-filled ratio from 1 to 1.5.

As an illustration, Fig. 3 shows that the most economical proportions for sand No. 10 is that in which the volume of cement-paste is equal to the volume of voids. From Fig. 1, it is seen that this proportion is 1

[4]It should be noted here that this value for the 'economy factor' of neat-cement mortar, as well as the other factors in Fig. 3, is based upon the assumption that 1 bag of cement gives 1 cu. ft. of cement-paste. If, as has been done in this paper, it is assumed that it requires 110 lb. of cement to make 1 cu. ft. of neat-cement paste, the cost of a cubic yard of cement-mortar would be $11.85 instead of $10.14, giving an 'economy factor' of 590.

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cement to 3.58 sand by volume, giving a tensile strength at 60 days of 525 lb. per sq. in., a compressive strength of 4000 lb. per sq. in., and an economy factor slightly over 1000.

The equations for economical mixtures, as indicated by this series of tests, may therefore be written:

$$\frac{\text{Volume of sand}}{\text{Volume of cement}} = \frac{1}{(1 \text{ to } 1.5) \times \text{proportion of voids in sand}} \quad (6)$$

or

$$\frac{\text{Weight of sand}}{\text{Weight of cement}} = \frac{\text{Aggregate specific gravity of sand}}{(1 \text{ to } 1.5) \times \text{aggregate specific gravity of cement} \times \text{voids in sand}} \quad (7)$$

If the properties of mortars from all sands vary with the variation of the void-filled ratio, the leakage, density, and yield should show similar effects for all sands. Fig. 4 shows the leakage of the various mortars plotted against the void-filled ratio; and this is another proof that the void-filled ratio is the proper basis of comparison of the properties of mortars.

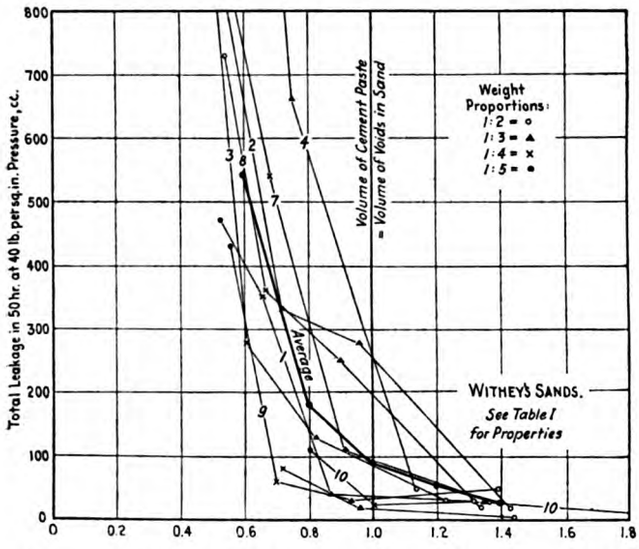

FIG. 4. VARIATION IN LEAKAGE OF MORTARS IN PROPORTION TO VOID-FILLED RATIOS

Conclusions Regarding Mortars. 1. Sand-cement mortars are not comparable in simple weight proportions because of the wide variation in the corresponding volumetric-proportions and the variations of the void-filled ratios.

2. Sand-cement mortars are not comparable in simple volumetric proportions because of the wide variations of the void-filled ratios.

3. The void-filled ratio has a general effect upon the strength, permeability, and economy of a mortar and undoubtedly affects the density and yield.

4. An important function of the cement-paste is to fill the voids in the sand.

5. Sand-cement mortars are properly comparable on the basis of the void-filled ratios.

6. The economical proportions for sand-cement mortars depend upon the void contents of the sands and may be expressed by equations 6 and 7.

7. The economy factor expresses the relative efficiency of mortars and may be determined by equation 5.

8. I do not find any general relation of silt-content, uniformity coefficient, and absorption to the efficiency of sands.

Concrete. Where concrete is made from either bank-run gravel, or a prepared concrete mix, and cement, it would be reasonable to expect the same general principles to apply as those previously stated for mortars. Where mortar is added to a coarse aggregate, such as rock, it is reasonable to assume that an important function of the mortar is to fill the voids in the rock.

A scientific test to determine the laws of concrete mixtures would be first, to determine the mortar of maximum density and the yield of mortar; second, to make progressive proportions of the mortar with the rock, using values of the ratio of the volume of mortar to the volume of voids in rock equal to 0.50, 0.75, 0.90, 1.00, 1.10, 1.25, 1.50, 2.00, and 3.00 with a view to determining that proportion giving maximum efficiency; and finally, to make additional progressive proportions, maintaining the ratio of fine to coarse aggregate of the 'efficient' proportion just determined, but increasing the amount of cement to 1.1, 1.2, 1.3, 1.4, 1.5, 2.0, and 3.0 times that used in the mortar of maximum density. The most economical proportions would be determined by the following equation:

$$\text{Economy factor} = \frac{\text{Compressive strength in lb. per sq. in.}}{\text{Cost of concrete in dollars per cu. yd.}} = \frac{\text{Compressive strength} \times \text{yield}}{C_r + \frac{P_s \times C_s}{P_r} + \frac{P_c \times C_c}{P_r}} \quad (8)$$

P_c, P_s, P_r being the volumetric proportions and C_c, C_s, and C the costs in dollars per cubic yard of cement, sand, and rock, respectively. The yield is based on the volume of the coarse aggregate (rock) as unity.

There are no test-data extant regarding the economical proportions of concrete. Some tests have been made by the U. S. Bureau of Standards using the void theory of proportioning in a limited way. The results of these tests will be analyzed in the following discussion and may throw some light on the subject.

The economy of any mixture depends largely upon the local cost of materials. If the cost of cement is twelve to fifteen times that of the aggregates, the economy of lean mixtures will be greater than if the cost of cement is comparatively lower. In Table VI, the economy factor for several 1:2:4 mixtures is compared with that of several void-theory mixtures, the factors having been computed by me from the results shown in Tables 8 and 12 of the Bureau of Standards paper.[5] The void-theory mixtures may be expressed by equations 9 and 10, the void-filled ratio (1 to 1.5) being 1.1 in every case both for the mortar and for the rock.

[5] Technologic Paper No. 58, U. S. Bureau of Standards.

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TABLE VI. ECONOMY FACTORS COMPARING 1:2:4 MIXTURES WITH VOID-THEORY MIXTURES

Kind of Aggregate.	Volumetric Proportions.	Age at Test, weeks. 4	13	26	52
Limestone	1:2.4:4.47	570	720	900	930
	1:3:6	620	690	750	...
	1:2:4	700	750	960	...
	1:2.4:4.45	470	570	680	860
	1:3:6	410	520	600	800
	1:2:4	450	590	660	880
	1:2.4:5.46	800	1000	1050	900
	1:3:6	790	810	1010	1030
	1:2:4	600	820	...	1040
	1:2.6:6.8	640	760	840	1000
	1:3:6	570	750	820	860
	1:2:4	830	...	830	1240
	1:2.4:5.81	670	900	930	710
	1:3:6	490	730	840	970
	1:2:4	540	820	810	970
Granite	1:2.4:4.92	470	720	750	920
	1:3:6	380	440	520	580
	1:2:4	540	820	720	980
Gravel	1:2.4:7.0	640	820	790	...
	1:3:6	410	540	610	...
	1:2:4	700	...	920	...
	1:2.4:6.2	940	930	1110	1220
	1:3:6	440	590	680	860
	1:2:4	860	1030	1090	1190
	1:2.3:6.4	750	930	990	...
	1:3:6	410	550	650	...
	1:2:4	700	...	970	...
Average	Void Theory	661	817	893	934
	1:3:6	502	624	719	850
	1:2:4	658	805	875	1050

[1] See Table 13, *Technologic Paper No. 58.*

The cost of the aggregates was assumed at $1.20 per cubic yard and the cost of cement at $12 per cubic yard. The yield of the various mixtures is necessarily assumed as unity, as it is not possible to approximate the yield closely by calculation.

It would appear from a study of this table, that the void-theory mixtures compare favorably with 1:2:4 mixtures, from the standpoint of efficiency. The two combinations of granite show the 1:2:4 mixtures as the most efficient. However, there are too few combinations to be conclusive.

In Table VII the economy factor is shown for various combinations of aggregates in three mixtures, 1:2:4, 1:3:6, and a void-theory mixture. In 33 comparisons, the ratios for the most economical mixtures are as follows:

Theoretical	1:2:4	1:3:6
18	15	
30		3
	30	3

The ratio of cement to total aggregate is 1:8.12 for the theoretical mixture, compared to 1:6 and 1:9 for the 1:2:4 and 1:3:6 mixtures. The fact that the 1:9 arbitrary mixture is much less efficient than an average 1:8.12 theoretical mixture and that the 1:8.12 theoretical mixture is somewhat more efficient than the 1:6 arbitrary mixture would appear to indicate that there is some basis for the void theory.

The 1:2:4 mixture generally appears to be an efficient one and the explanation may be the efficiency of the mortar. As the voids in sands are seldom below 33% or above 50%, the ratio of cement-paste to voids for the 1:2 mortar varies from 1 to 1.5, which corresponds to the limits previously determined for efficient mortars. Rock seldom shows less than 35% or more than 50% of voids, so that in a 1:2:4 mixture the volume of mortar will vary from 1 to 1.5 times the volume of voids in the rock. A 1:3:6 mixture is seldom an efficient one because a 1:3 mortar is seldom efficient, few sands showing less than 33% voids.

TABLE VII. COMPARISON OF THE ECONOMY FACTORS OF CONCRETES PROPORTIONED BY DIFFERENT METHODS

Kind of Aggregate.		Age at Test, weeks. 4	13	26	52	78	104
		1:2:4 MIXTURES—2 COMBINATIONS.[1,4]					
Granite	Minimum	490	630	700	990	....	....
	Average	510	720	710	1010	....	....
	Maximum	540	820	720	1040	....	....
		VOID-THEORY MIXTURES—2 COMBINATIONS.[2,4]					
	Minimum	410	510	590	880	....	....
	Average	440	620	670	900	....	....
	Maximum	470	730	750	920	....	....
		1:2:4 MIXTURES—20 COMBINATIONS.[1]					
Limestone	Minimum	260	360	450	780	1140	1280
	Average	570	680	750	990	1260	1410
	Maximum	820	820	940	1360	1520	1500
		VOID-THEORY MIXTURES—20 COMBINATIONS.[3]					
	Minimum	300	390	410	470	1210	....
	Average	600	760	800	890	1330	1710
	Maximum	890	1020	1050	1440	1590	....
		1:2:4 MIXTURES—10 COMBINATIONS.[1]					
Gravel	Minimum	200	300	390	440	....	....
	Average	550	600	740	810	....	....
	Maximum	870	1040	1090	1190	....	....
		VOID-THEORY MIXTURES—8 COMBINATIONS.[2,3]					
	Minimum	280	420	460	530	....	....
	Average	560	680	740	820	....	....
	Maximum	1080	930	1110	1220	....	....

[1] From Table 8 of *Technologic Paper No. 58.*
[2] From Table 12 of *Technologic Paper No. 58.*
[3] The two last combinations of Table 12 have been omitted since they were not common to both mixtures.
[4] Two combinations in common to both mixtures used.

Conclusions Regarding Concretes. 1. An important function of a mortar in concrete is to fill the voids in the coarse aggregate.

2. The efficiency of a concrete mixture depends largely upon the efficiency of the mortar.

3. For economical proportions the volume of cement should be equal to or greater than the volume of voids in the sand but should not exceed 1½ times the voids in the sand, and the volume of mortar should be equal to or greater than the volume of voids in the coarse aggregate but should not exceed 1½ times the voids in the coarse aggregate.

4. The equations for economical mixtures may be stated as follows:

$$\frac{\text{Volume of sand}}{\text{Unit volume of cement}} = \frac{1}{(1 \text{ to } 1.5) \times \text{proportion of voids in sand}} \quad (9)$$

$$\frac{\text{Volume of rock}}{\text{Unit volume of cement}} = \frac{\dfrac{\text{Volume of sand} \times \text{yield of mortar}}{\text{Unit volume of cement}}}{(1 \text{ to } 1.5) \times \text{proportion of voids in rock}} \quad (10)$$

5. The economy factor expresses the relative efficiencies of concrete mixtures and may be determined by equation 8.

Loss of pressure in an ell is approximately equal to that in a piece of straight pipe with a length equal to 40 diameters of the fitting. The loss in a globe-valve corresponds to the loss in a pipe with a length equal to 60 diameters of the valve.

The construction of a canal from Milan to Venice, 235 miles, has been proposed. It would have a bottom width of 75 ft. and a depth of 8.3 ft. The estimated cost is $8,685,000.

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Drop in Pressure of Compressed-Air Hose

By WALTER S. WEEKS

Last year W. W. Sprague and E. H. Wisser, under my direction in the Mining College of the University of California, made a large number of tests to determine the drop in pressure that compressed air undergoes in passing through a 50-ft. length of commercial air-drill hose. These tests were made for the purpose of furnishing to engineers data that might aid them in selecting a hose.

Tests were made on ¾-in. and 1-in. hoses, which were lent by different manufacturers. The drop in pressure, with the same amount of air passing through, varied somewhat with different types of hose. The charts given on the opposite page may be considered representative of an average hose. The pressure marked on each curve is gauge-pressure at the entrance of the hose. The drop shown on the charts includes the drop through the hose-fittings, which in each case consisted of two couplings and two spuds. An approximate test was made on the drop through the fittings alone, and the drop was so slight that it would have been a waste of time to pursue it further.

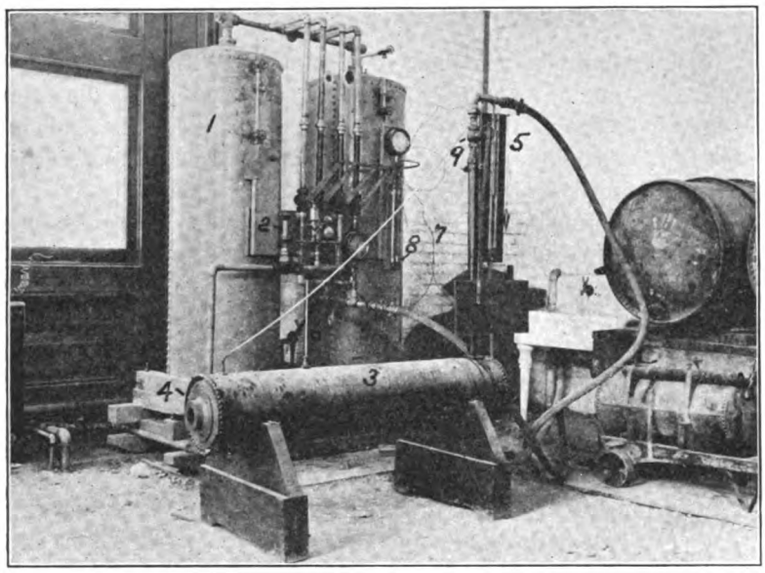

FIG. 3. APPARATUS FOR TESTING HOSE

In addition to the data given by the charts a few more points may be of interest. The buyer should make sure that the hole in the hose is of the specified size. The hose with the most 'give' has the least drop in pressure, because when it is under pressure the diameter of the hose is slightly increased. The more expensive hoses which have a layer of rubber between the wraps of duck, apparently have more expansion, and consequently conduct air with less drop in pressure than more rigid hoses. Wire-wound hoses are very rigid. They have the additional disadvantage of becoming closed when struck by a falling piece of rock. The inside of a wire-wound hose is often corrugated by the tight winding. These corrugations increase friction and constrict the opening.

If a 50-ft. hose is coiled in four or five coils the drop in pressure will be increased by about 17%.

Manufacturers rate their drills in free-air consumption at sea-level. The free air on the charts is at sea-level, so the rating given by the drill-maker is used to find the drop in pressure. The effect of the altitude at which the drill is used may be neglected.

The method of conducting the tests was briefly this: Referring to Fig. 3; air was supplied to a receiver (1) through a reducing-valve (2), which maintained the pressure at any desired figure. One end of the hose was on the receiver and the other end on a tank (3), which was fitted with a low-pressure nozzle (4), a water manometer (5), and a thermometer (6). From each end of the hose a small copper tube (7) led to a mercury manometer (8). The air passing through the hose was controlled by a valve (9) leading into the tank.

From a chart the water-gauge was determined; this signified that a given amount of free air was passing through the nozzle. The valve in the tank was set so that this pressure was maintained in the tank. The difference of level in the mercury manometer gave the drop in pressure with a given amount of air flowing through, with a given pressure in the receiver.

Cost of highway surveys in Illinois has recently been discussed in a report of the State Highway Department. Since 1913, 400 surveys have been made by the Department, covering 1100 miles of road. The average cost was $26.40 per mile, and the average progress per day was 0.84 mile. The cost given includes salaries, transportation, supplies, and board and lodging. Instrument-men were paid $4 per day, helpers, $2.50, and teams were hired for $3 per day. It should be remembered that these surveys were made in a level country, with little or no clearing, and in most cases along section-lines. In a mountainous country requiring heavy clearing, and where an irregular alignment was needed, the cost might be several times that amount.

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Chemistry

Next to the work of creation itself, possibly the most marvelous achievements which have been wrought in material things on this planet have come as a result of the work of the chemist. Indeed, chemistry would seem to come nearer to truly creative work in material things than anything else of which man knows. Leading in all human progress is the chemist. Whether it be dealing with the soil, increasing its fertility and enlarging the output of foodstuffs; whether it be in extracting fertilizers from the air with which to save civilization in the years to come from starvation by lack of food; whether it be in the creation of explosives or the making of dyes, the production of medicines or the thousand and one other things which enter into every phase of human activity, chemistry is the dominating power. In olden times—and indeed by many people of today—chemistry is sometimes associated with apothecary shops. For many years people thought that the chemist was a druggist or apothecary, and there are still some people in the land who associate these interests and do not realize the broader work of the chemist in every line of human endeavor. Without the chemist there could be no agricultural advancement; without the chemist there could be no manufacturing growth; without the chemist there could be created none of the drugs and medicines to alleviate human suffering. It is, however, largely due to the utilization of chemistry in the creation of industries, agricultural and manufacturing, to which the world is now giving its greatest attention.

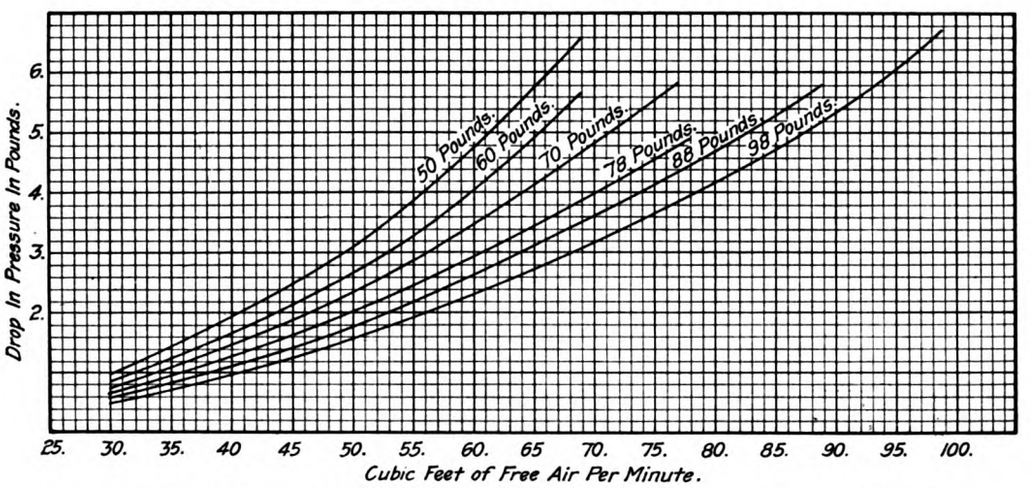

Fig.1 Curves for 50 Feet of ¾ Inch Woven Hose with Sullivan Fittings Showing Drop In Pressure Plotted against Air Delivered at Different Pressures.

We have entered a world war which is in reality a war of chemistry and mechanics, largely of chemistry. When Germany invaded Belgium it awakened the world to a realization of the fact that this country, as others, had for years been dependent upon German chemistry for myriads of things which should have been produced at home. We were instantaneously cut off from a supply of potash, though we should have searched the world for potash or produced it from by-products, as we are now beginning to do. We were cut off from dyes, though there are more resources in this country for dye-making than Germany ever dreamed of having. We had permitted ourselves to be handicapped, and had we at that time been forced into war our aid would have of necessity been very small, because chemistry had not made it possible for us to do the things which are now essential to maintain war. Within the last three years, however, the chemists of this country have almost been born anew or, rather, a new birth has come to chemistry. Thousands of chemists have concentrated their attention with untiring zeal upon the opening up of new avenues for producing the things which heretofore were brought from other lands. They are seeking to make this country independent of Germany, to make it self-reliant and self-contained.—From the 'Manufacturers Record.'

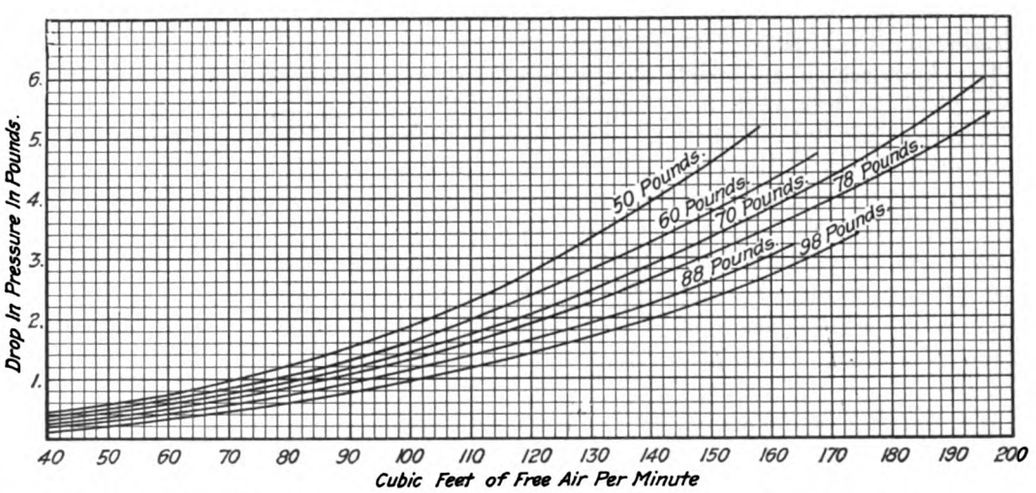

Fig.2. Curves for 50 Feet of 1-Inch Wrapped Hose with Sullivan Fittings Showing Drop in Pressure Plotted against Air Delivered at Different Pressures

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The Supply of Gasoline

By MILTON A. ALLEN

A shortage of gasoline has been threatened recently and it has been announced that if the consumption was not reduced voluntarily during the War, legislative regulation would be necessary.

Prior to the War the United States produced 65% of the world's petroleum. Since then the supplies of Russia, Rumania, and Austria have been cut off, thereby placing the burden of production upon the United States. Besides this there is the ever-increasing domestic demand.

In 1914 the marketed production of American petroleum was 250,000,000 barrels and this increased to 281,000,000 bbl. in 1915. Our estimated resources are 5,500,000,000 bbl., or 20 years' supply at the present rate of consumption. The future source of gasoline to supply the increasing consumption and to take the place of our depleting resources is a serious problem. Most of the crude petroleum yields only a small proportion of gasoline and burning naphtha or oils that lend themselves readily to being manufactured into gasoline by cracking. The Mexican, Californian, Texan, and some Mid-Continental oils are of this class. Gasoline must therefore be supplied by the high-grade paraffine-base oils. The best of these yield only 15 to 25% of refined gasoline and naphtha.

The Appalachian and parts of the Mid-Continental fields yield the bulk of these paraffine-oils, but this represents less than 40% of the total crude petroleum output in the United States. From this it is seen that our gasoline supply is limited and restricted. During the year ended June 1915 the United States exported 244,000,000 gal. of gasoline and naphtha that could have been diverted to home consumption. It will be interesting to consider the possible source of gasoline other than crude petroleum, casing-head gasoline, and cracked gasoline.

The sources from which oil can be obtained in quantity for making motor-spirit are natural bitumen, highly volatile coal (lignite and cannel), and shale.

Prior to the discovery of oil in this country in the 'fifties, the cannel-coal deposits of Kentucky were mined and the coal distilled as it is in Scotland today. The oil yielded excellent lighting-oil or kerosene, lubricating oils, and tar. Similarly the albertite deposits of Canada were worked and distilled. Both these industries were forced out of the market when natural petroleum was produced in quantity.

For many years the Scottish oil-shales have been distilled at low temperatures (1000° F.). The richer shales, from which as much as 40 gal. per ton was obtained, are now exhausted; the average yield is now between 20 and 25 gal. only. In the process of distillation used, a large yield (45 lb.) of ammonium sulphate is obtained. The small yield of gas is scrubbed and used in the distillation process and for power. The crude oil is refined, yielding naphthas, burning-oils, gas-oils, lubricating-oils, and paraffine-wax. In spite of the increased price of chemicals, the improvements in retorts and in recovery, together with the installation of electric power have enabled the industry to operate at a profit. It is a fact, however, that in depth the Scottish shale yields less oil.

Large quantities of natural bitumen, similar to albertite, are found in Utah, Oklahoma, and Colorado. It is estimated that there are 32,000,000 tons of uintaite in the known veins in Utah alone. Analyses of albertite and uintaite are given herewith:

	Albertite %	Uintaite %
Volatile	60.0	56.5
Fixed carbon and ash	39.5	43.0
Sulphur	0.5	1.5

Experiments made in Scotland under working conditions showed a yield of 134 gal. of oil per ton of albertite. The yield of uintaite should approach that of albertite.

The market demands for cannel-coal are limited, hence the present output is small; it is used to enrich gas in gas-works and as a grate-coal in some localities. For this reason large areas of cannel-coal in Ohio, Kentucky, West Virginia, Indiana, and Tennessee have not been developed. These coals vary in volatile content from 35% to 54%, and in many instances they approach 60%. It is estimated that there are millions of tons of workable cannel-coal in Kentucky alone.

An analysis of a typical Kentucky cannel-coal shows

	%
Moisture	2.4
Volatile	50.3
Fixed carbon	43.3
Ash	3.4
Sulphur	0.6

This coal holds considerably less ash than the European cannels, hence the greater possibilities of disposing of the coke by-product if the coal is distilled like the Scotch shale. The coal residue could also be burned in producers and electric power generated on the side.

Experiments in distillation at low temperature of high volatile cannel-coal show that it yields from 35 to 60 gal. of dry tar-oil, the amount depending on the percentage of volatile in the coal and the temperature at which the destructive distillation is conducted. These cannel-coal tar-oils are high in paraffine, and the heavier fraction could readily be cracked to yield a high percentage of motor-spirit.

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For many years in England cannel-coal was used in gas-works as an enricher; but if large quantities were employed the tar by-product was difficult to sell to the tar-distillers because of its high percentage of paraffine. This bears out recent experiments, except that the percentage of paraffine hydro-carbons is considerably increased when the coal is treated at a low temperature as in the Scotch shale distillation. The advantages of cannel-coal distillation for tar-oils over the Scotch shale would be that the residue or coke could be used either for power purposes on a large scale, sold directly, or ground and made into briquettes. Ammonium sulphate would be a by-product as in the Scotch shale industry and the yield would probably be large. Experiments on albertite yielded 65 lb. ammonium sulphate per ton.

Apart from the tar-oils the gas when scrubbed yields benzene and toluene and some light oils. The benzene and toluene could be mixed with some of the light oils similar to the use to which casing-head gasoline is put. Benzol has been used in France as a motor-spirit for many years.

In many of our central, northern, and western States, there are hundreds of square miles of lignite. Canadian lignite deposits, it seems, are inexhaustible. Lignite is useless there as a fuel because of its low heating-value. If the lignites are subjected to low-temperature distillation they will yield from 30 to 40 gal. of dry tar-oils, depending on the volatile content of the lignite and the temperature of the destructive distillation. The residual coke can be used similarly to that from cannel-coal.

In Nova Scotia, New Brunswick, and in our western States are large areas in which oil-shale is known to exist. These shales resemble the oil-shales of Scotland. Experiments made on shales from Nova Scotia and New Brunswick yielded from 40 to 65 gal. oil per ton, the ammonium-sulphate by-product varying from 67 to 110 pounds. The following is an analysis of these shales:

	%
Moisture	1.00
Volatile	45.32
Fixed carbon	1.29
Ash	50.69
Sulphur	1.70

In the Carboniferous system of Kentucky above the cannel-coal deposits are bands of shale similar in composition; also there are separate beds of workable shale. These separate shales show the following analysis:

	%
Moisture	0.9
Volatile	43.0
Fixed carbon	13.1
Ash	42.5
Sulphur	0.5

A yield of 75 to 85 gal. of oil has been obtained from French shale deposits having the following analysis:

	%
Volatile	44.4
Fixed carbon	25.0
Ash	30.6

No sulphur exists in the oil. This resembles a high-ash cannel-coal.

From the results given, it will be seen that the shales in almost all cases give a high yield of oil. Prior to the War the oil from the Scotch shale was not cracked for motor-spirit, but there is every reason to believe that this now is being done.

In crude experiments in the cracking of lignite tar-oils, after the extraction of the light naphthas, a yield of 40% of motor-spirit has been obtained. It can be expected that the tar-oils of cannel-coal and the shale-oils, which carry a larger percentage of paraffine-oil, will yield a larger percentage of motor-fuel on cracking, and will be more amenable to such treatment. The processes now being used in the cracking of petroleum in this country are the Burton, Hall, and Rittman. The Hall process is being applied successfully in England and Russia.

The War has created a demand for benzol and toluol that did not exist before. Therefore, they were not recovered in the by-product plants. It is doubtful if these products will fall below the price of gasoline after the War because of their value as motor-spirit. Gasoline will probably not go lower.

Considering the low costs of mining and treatment of the Scotch shales by the uneconomical method practised, it is difficult to see why the shales, natural bitumens, cannel-coals, and lignites would not yield large quantities of gasoline profitably at the present price, and at the same time develop resources that are idle for want of profitable use, by the adoption of a modification of the most recent continuous retorts of the Woodall-Duckham or Glover-West type to suit low-temperature work, together with a modern cracking plant.

A new metal as light as aluminum and as strong as steel is now made in the electric furnace. It possesses unusual anti-corrosive properties also. The U. S. Government is testing a pump made of this new metal, for pumping sea-water. It is said to be a chemical union of aluminum with other elements and not an alloy. The name of the new product is 'acieral', probably from the French word *acier,* steel, with the *al* to signify aluminum, or 'steel-aluminum.' It is understood to contain about 92 to 97% aluminum, with 3% nickel and other metals. The chemical reaction is obtained by the use of a secret flux. Its color is white and it has a compact texture similar to the best steel. It is as sonorous as bell metal and has a good conductivity for use in electrical work. Castings made from it show high tensile strength, and when rolled into rods or sheets its strength nearly doubles. It can be cast in sand or die cast, with or without pressure, and it flows well when being cast. It may be forged hot or cold, and can be annealed, drawn, or rolled into shapes. It is resistant to all acids, hot or cold, except hydrochloric, and it resists oxidation by the air when damp, at all temperatures, even when salt is present. Its greatest use is for aeroplanes and automobiles. With aluminum selling at 60c. per lb., the new metal will sell at $1. It was discovered by M. de Montby.

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Municipalities With City Managers

The following table, taken from 'The Short Ballot Bulletin,' has been corrected to July 1. 1917:

City	Population, 1910	Date in operation	Manager	Salary
Sumter, S. C.	8,109	Jan. 1913	E. S. Shuler	$1,200
Hickory, N. C.	3,706	May 1913	J. W. Ballew	1,500
Morganton, N. C.	2,712	May 1913		
Dayton, Ohio	116,577	Jan. 1914	H. M. Waite	12,500
Springfield, Ohio	46,921	Jan. 1914	C. E. Ashburner	6,000
Phoenix, Ariz.	11,134	Jan. 1914	R. A. Craig	5,000
La Grande, Ore.	4,843	Jan. 1914	Fred Currey	2,400
Amarillo, Tex.	9,957	Jan. 1914	M. H. Hardin	2,400
Cadillac, Mich.	8,375	Jan. 1914	T. V. Stephens	2,500
Manistee, Mich.	12,381	April 1914	Charles E. Ruger	2,000
Montrose, Colo.	3,252	Jan. 1914	J. E. McDaniel	1,800
Taylor, Tex.	5,314	April 1914	W. F. Dozier	2,600
Denton, Tex.	4,732	May 1914	Sam. C. Gary	.....
Collinsville, Okla.	1,324	Sept. 1914	F. A. Wright	1,500
Big Rapids, Mich.	4,519	1914	Walter Willets	1,200
Jackson, Mich.	31,433	Jan. 1915		
Sherman, Tex.	12,412	April 1915	O. J. S. Ellingson	2,400
Bakersfield, Cal.	12,727	April 1915	F. S. Benson	3,000
Yoakum, Tex.	4,657			
Beaufort, S. C.	2,486	April 1915	H. G. Otis	2,400
Tyler, Tex.	10,400	April 1915	Clay Hight	.....
Newburg, N. Y.	27,805	Jan. 1916	Henry Wilson	4,000
Sandusky, Ohio	19,989	Jan. 1916	George T. Lehrer	3,600
Ashtabula, Ohio	18,266	Jan. 1, 1916	J. Warren Prine	2,500
Niagara Falls, N. Y.	30,445	Jan. 1916	Ossian A. Carr	5,000
Wheeling, W. Va.	41,641	July 1917	Charles O. Nagle	8,000
Alpena, Mich.	12,706	April 1916	Harrison G. Roby	2,500
Santa Barbara, Cal.	11,659	Jan. 1, 1918		
San Angelo, Tex.	10,321	April 1916	E. R. Wells	2,500
St. Augustine, Fla.	5,494	April 1915	W. L. Miller	3,600
Westerville, Ohio	1,903	Jan. 1, 1916	Ray S. Blinn	1,500
Elizabeth City, N. C.	8,412	1915	J. C. Commander	.....
Webster City, Ia.	5,208	Jan. 1, 1916		
San Jose, Cal.	28,946	Jan. 1, 1916	Thomas H. Reed	6,000
Portsmouth, Va.	33,190	Jan. 1916	T. B. Schertzer	4,000
Albion, Mich.	5,833	Jan. 1, 1916	A. L. Sloman	.....
Brownsville, Tex.	10,517	Jan. 1, 1916	Frank R. Williams	3,000
Petoskey, Mich.	4,778		W. R. Caldwell	2,000
East Cleveland, Ohio	9,179	Jan. 1918		
Grand Rapids, Mich.	112,571	July 1, 1917	Gaylord C. Cummin	10,000
Alameda, Cal.	23,383	March 1917	Charles E. Hewes	4,000
Hot Springs, Ark.	13,434	May 1917	Charles H. Weaver	.....
Wichita, Kan.	52,450	March 1917	Lewis R. Ash	10,000
Eldorado, Kan.	3,129	March 1917	Bert C. Wells	.....
Bryan, Texas	4,132	Mch. 23, 1917		
Goldsboro, N. C.				

In addition there are officers called managers in the following towns, which do not have commission-manager charters or lack some of the fundamental features of the plan: Staunton and Fredericksburg, Va.; Norwood, Mass.; San Diego, Cal.; Glencoe, Ill.; Grove City and Titusville, Pa.; Morris, Minn.; Clarinda and Iowa Falls, Iowa; Clark, S. D.; Tucson, Ariz., and Roswell, N. Mex.; Terrell, Tex.; Grand Haven, Mich.; Alhambra, Cal. In Canada: Port Arthur, Ontario, and Maissonneuve, Quebec. It is probable that over one million people are now living in cities having the city-manager plan in some form or other.

There are State laws permitting cities to adopt this plan in Massachusetts, Virginia, Ohio, Iowa, Kansas, Idaho, Montana, South Dakota, and North Carolina.

Cement for fastening metal parts to marble, as in the case of a switchboard, may be made of plaster-of-paris, 30 parts; iron filings, 10 parts; sal-ammoniac, ½ part. After mixing these ingredients, add enough acetic acid to make a thin paste. Use immediately after mixing.

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Absorption Method for Extracting Gasoline From Natural Gas

By GEORGE A. BURRELL, P. M. BIDDISON, and C. G. OBERFELL

Bulletin 120 of the U. S. Bureau of Mines, 'Extraction of Gasoline from Natural Gas by Absorption Methods', which has recently been issued, contains the following summary of data regarding the process:

The absorption method of extracting gasoline from natural gas consists in bringing the gas in contact with an oil heavier than gasoline, such as a petroleum distillate of about 34° B., to absorb the gasoline from it, and then separating the gasoline from the oil by distillation. The oil is used simply as a carrier of the gasoline from the absorption-tank to the still, and may be used over and over again.

In plants using compression and condensation methods only, casing-head natural gas that is comparatively rich in gasoline vapor—carrying upward of three-fourths of a gallon of gasoline per 1000 cubic feet of gas—is treated, whereas so-called 'dry' natural gas, such as is used in cities, towns, and factories for heating, lighting, and other purposes, can be treated by the absorption process. In 1914 about 591,000,000,000 cu. ft. of this kind of natural gas was used in the United States. Most of this natural gas carries as much as 1 to 2 pints of gasoline per 1000 cu. ft. of gas. Probably 75,000,000 gal. of gasoline per year could be recovered by passing the gas through absorption plants before it is marketed. It is also true that casing-head gas that is too lean to treat by compression methods can be treated by the absorption method.

The removal of the gasoline does not reduce the heating value of the gas to an appreciable extent. In the case of natural gas from two particular fields, extracting the gasoline lowered the heating value only 3% in one case and 2.2% in the other.

A further advantage of the process, apart from the value of the gasoline recovered, lies in the fact that gasoline if left in the gas-lines destroys the rubber in pipe-couplings. The cost of replacing these rubbers and repairing broken connections, and the resulting loss of natural gas, has been a large item of expense in the operating costs of gas-transportation companies.

The importance of the absorption process of extracting gasoline from natural gas increases with the demand for gasoline. The method is practically identical with the process of extracting benzol and toluol from coke-oven gases. A difference lies in the fact that coke-oven gases are treated at about atmospheric pressure, whereas much natural gas must be treated at pressures as high as 200 to 300 lb. per square inch, because it is not desirable to disturb the carrying-system.

As nearly as can be determined the first large-scale installation for extracting gasoline from natural gas by the absorption process at high pressure was constructed at Hastings, West Virginia, in 1913. The plant was built following experiments by G. M. Saybolt, of the operating company.

Two methods can be used in testing natural gas as regards the practicability of extracting gasoline from it by the absorption process. In the laboratory method the gasoline is frozen out of the natural gas and its pressure and volume determined. In the field method, a small absorber and a gas-meter are taken to the well or pipe-line to be tested for natural gas, the gas is passed through the absorbent oil, and the extracted gasoline is distilled from the oil. The results duplicate on a small scale those in a commercial plant.

All natural gas, except that which contains methane as the only combustible gas, contains gasoline vapor. However, in gas from some wells the gasoline-content may be small. This is sometimes because the gas is under high pressure and the gasoline vapor, because of its greater density at this high pressure, is not produced in quantity until the pressure is relieved. But even high-pressure wells represent potential sources of gasoline supply in that the gas will carry commercial quantities of gasoline vapor as the pressure declines.

Tests on natural gas from two different fields reported in the bulletin showed 1 pint and 1.5 pints, respectively, of gasoline per 1000 cu. ft. About 50,000,000 cu. ft. of natural gas per day was available for treatment.

The oils used in the experiments to absorb the gasoline were petroleum distillates that had a specific gravity of 35° B., and which started to boil at 400° to 482° F. It is necessary that the boiling-point of the oil used be much higher than the boiling-point of the gasoline to facilitate the extraction of the latter by distillation.

Tests were made with a plant of fairly large proportions, capable of handling 15,000 to 30,000 cu. ft. of gas per hour. The principal features of the plant consisted of an absorber where the natural gas and absorbent oil were brought in contact with each other, a heat-exchanger where the oil with its absorbed gasoline was heated before going to the still, a steam-still where the gasoline was extracted from the oil, a cooler where the hot oil from the still was cooled before receiving another charge of gasoline, pumps, and a weathering-tank.

Several different types of absorbers were tried. The one giving the best results consisted of a tower filled with pebbles, in which the oil flowed downward and the gas upward.

An increase in the temperature of the oil in the absorber from 75° F. to 85° F. lowered the gasoline yield about 0.3 pint per 1000 cu. ft. of gas. An increase in

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the pressure of the gas from atmospheric pressure to 110 lb. per square inch increased the yield from 0.7 pint to about 2 pints of gasoline per 1000 cu. ft. of gas.

The gravity of the gasoline obtained varied between 77° and 85° B. The boiling-point ranged from 80° to 300° F. The evaporation-loss was about 11% in 24 hours as compared to 2.4% from a 'straight' refinery-gasoline having a gravity of 60.4° B. The vapor pressure of the gasoline ranged from 1 lb. at 70° F. to about 5 lb. at 100° F. This is important because it shows that the gasoline can be safely shipped in tank-cars.

The absorption process can be profitably operated at low pressures.

As good results can be obtained from casing-head gas with the absorption process as with the compression process. However, where the residual gas from the plant has to be forced into a pipe-line at high pressure there is no advantage to installing an absorption plant, because a compressor would be needed anyhow.

A promising field for the absorption process lies in the treatment of gas from oil-wells producing from a sand into which air has been forced under pressure to increase the oil production. This gas, as it flows from the wells, can be treated by the absorption process and the gasoline it contains extracted.

The amount of power required for the operation of an absorption plant will vary from 0.018 to 1.443 boiler horse-power per 1000 cu. ft. of gas treated per hour for gas containing 0.0625 to 5 gal. of gasoline per 1000 cu. ft., and the amount of water from 1.46 to 116.8 gal. per 1000 cu. ft. of gas. The rate of flow of the absorbing-oil will vary from 6 to 60 gal. per 1000 ft. of gas treated per 24 hours, for gas that contains from 1 pint to 2.5 gal. of gasoline per 1000 cubic feet.

A successful use of naphtha as an absorbent for gasoline is found in the absorption in the naphtha of waste gases from compression plants treating casing-head gasoline. Some tests were made in which natural gas was passed into naphtha with a gravity of about 55° B. When the naphtha had absorbed all the gasoline that was desired, it was removed and fresh naphtha substituted. The yield of gasoline was 300 to 500% greater than that by the oil-absorption and distillation process. In some tests the naphtha besides being increased in volume owing to the absorbed gasoline, was raised in gravity to 60° or 62° B. An objection to the process lies in the fact that a large amount of naphtha has to be handled—at least seven tanks of naphtha for each tank of gasoline obtained. If the naphtha is permitted to absorb too much gasoline its vapor pressure is raised too high for safe transportation.

There are possibilities in the application of the absorption method to casing-head natural gas, much of which is too lean to be treated by compression and condensation methods.

Asbestos becomes a good conductor of heat when wet, therefore it should not be used for insulating in damp places.

EFFECT OF SULPHIDE COMPOUNDS ON CEMENT*

By J. C. WITT

An investigation of the effect of sulphide compounds on cement was made by using known proportions of sodium sulphide in the water used in mixing the cement and mortar. Several brands of cement were used singly and in combination. Briquettes of both cement and mortar were made and tested. The following conclusions were reached:

1. The setting-time of a cement is greatly modified by the presence of sodium sulphide. With low concentrations the set is retarded, but after reaching a maximum, further additions accelerate the set. In general, the cements highest in iron-content are most sensitive to this influence.

2. There is a decided decrease in tensile strength.† The proportionate loss varies with the concentration of the sulphide and with the iron-content of the cement. The briquettes appear normal in every respect but color. There is no cracking nor distortion.

3. In most cases sulphide may be present in concentrations up to one gramme per litre without causing the tensile strength to fall below United States Government specifications.

4. Certain results indicate that a colloid is formed by the action of sodium sulphide on the iron in the cement.

5. Based on the results of both chemical and physical observations, the following explanations of the decrease in tensile strength are offered: First, the precipitated colloid forms films of inert material through the cement and interferes with the cohesion. Second, when the colloid is precipitated a portion of the dissolved calcium hydroxide is removed from solution. Since the latter substance is an important factor in the strength of cement, it is to be anticipated that when some of it is removed the strength will be lowered.

6. It is probable that a number of other factors influence the effect of sulphide on cement. Among these may be mentioned the fineness of the cement, the temperature at which it is mixed, the proportion of water used, and the amount of dissolved calcium hydroxide.

An irrigation project that will supply 50,000,000 gal. of water daily is now under construction on the island of Maui, Hawaiian Islands, by the Pioneer Plantation. The main part of the project is a tunnel 1½ miles long, cutting across five ridges and replacing several miles of metal flume. The water is also to be used for the development of electric power. The project includes the replacement of 1½ miles of metal flume by a concrete-lined ditch, and the construction of concrete bridges over the main ditches in place of wooden structures.

*Abstract from 'The Philippine Journal of Science'.

†The only specimens yet broken are those during the first sixty days.

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METHODS OF REMOVING STUMPS

Bulletin No. 91 of the Agricultural Experiment Station of the University of Idaho on 'Methods of Clearing Logged-Off Land,' while intended primarily for the use of farmers, contains a number of valuable suggestions regarding methods of doing any class of work requiring grubbing. The data contained in the bulletin were obtained mainly from experimental work done by the experiment station on several tracts of logged-off land in the Palouse River valley. The soil was a clay-loam and the stumps were of western yellow pine, douglas fir, and western larch.

The use of powder is the quickest method of removing stumps, and, consequently, is the only feasible method in the case of most construction work. The placing and loading of holes depends mainly on the character of the root-system. In the work done by the experiment station one hole was found to be sufficient for stumps up to 18 in. diam., two holes for stumps up to 30 in., and three holes for 40-in. stumps. Four and five holes were sometimes needed for the larger stumps. For stumps less than 48 in. diam. the depth of the hole should be equal to the diameter of the stump, but 48 in. is as deep as is advisable to make the holes, regardless of the size of the stump. Where more than one charge is placed under a stump, an electric battery should be used for firing, since it is practically impossible to arrange time-fuses so that the explosions should be simultaneous, and this is necessary for the best results. The amount of powder that is recommended varies from 0.6 lb. for a 6-in. stump up to 17.5 lb. for a 56-in. stump. The cost of grubbing stumps with powder, including piling and burning, will range from $35 to $150 per acre, according to the character of the timber. Where clearing and grubbing are done at the same time, as on most construction work, an exact segregation of the cost would be impossible.

There are three principal methods of removing stumps by the use of fire, burning from the outside of the stump or char-pitting, burning from the centre of the stump by boring, and burning from the centre by sawing the stump off and raising it. The cost of the first two methods is from $10 to $75 per acre. The cost of the third is usually a little less. In char-pitting, the stump is set on fire and after the fire is well started, it is confined until the stump is consumed. This method works well when the soil is of such a nature that it bakes during burning. It is not satisfactory with a sandy soil, or a soil containing much vegetal matter. In boring, a hole is drilled in the centre of the stump to a point well below the ground-line, and an oblique hole bored from the ground-line to join the first hole. A fire is started in the hole with a blow-torch or similar means. After the fire is started it is banked so as to keep it going slowly until the stump is dried thoroughly. A ½-in. ship-auger with a 4-ft. barrel is about as good a tool for boring stumps as some of the more expensive machines. In a variation of the boring method the stump is cracked with powder before burning.

In sawing, the stump is cut at the ground-level, and then elevated from two to four inches on wooden skids, or preferably stones, and allowed to dry. A fire is then started under the elevated stump and confined as for char-pitting. The great advantage of this method is that as the stump burns it settles, keeping the burning parts in the best position for maintaining combustion.

Hoods are used in connection with any of the above burning-methods to assist in confining the heat. They can be made of No. 28 gauge galvanized iron and cost from $10 to $25. They can be used in connection with a condenser for obtaining the liquid produced by the destructive distillation of the stump. In one case, 220 gal. of acid liquor and 20 gal. of tar were obtained during the burning of a 4-ft. yellow-pine stump. The tar can be used as a substitute for coal-tar creosote for preserving fence-posts, etc. The liquor is mainly water, but contains enough wood-dyes as to make it valuable for staining wood.

Stump-pullers are of various kinds. The simplest is the common lever and fulcrum. It can be used with advantage by two men in removing trees up to 12 in. diam. that have no tap-root. Capstan-machines will pull almost any stump up to 30 in. diam., but stumps of this size are so hard to handle after they are pulled that these machines are generally used on smaller stumps or in connection with powder. Tripod-pullers are nearly as powerful as the capstan-machines. Where land is to be leveled after grubbing, they have the advantage that the earth removed with the stump can be taken off the roots while the stump is still over the hole. The cost of clearing with stump-pullers is usually rather more than for char-pitting.

For operations on a large scale donkey-engines or traction engines can be used to advantage. Caterpillar engines are particularly useful for uneven or swampy ground. The cost of grubbing with engines is generally from $35 to $100 per acre. In grubbing with either stump-pullers or engines, some use is generally made of powder and of burning the stumps in place.

Where time is no object, the cheapest and most satisfactory method of getting rid of stumps is to pasture the land for a few years, allowing the smaller stumps to decay completely. The larger stumps will also decay sufficiently to make their removal much easier than at first.

The proportion of surfaced roads to total mileage in the various States is the subject of a report by the U. S. Office of Public Roads. The highest proportion is in Massachusetts with 47.6% of the roads surfaced. Then comes Indiana with 42.5%; New Jersey, 40.5%; Ohio, 36.5%; Rhode Island, 34.5%; Kentucky, 23.2%; New York, 22.7%; Connecticut, 22%; and California, 20.2%. These figures are for all types of surfacing, including gravel, which latter fact accounts for the high position of Indiana and Kentucky. California stands at the head of the States that are comparatively thinly settled.

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SPREADING FLOOD-WATERS IN THE DEBRIS-CONE OF THE SANTA ANA RIVER

A paper appearing in the 'Proceedings of the American Society of Civil Engineers' on 'Hydraulic Phenomena and the Effect of Spreading of Flood-Water in the San Bernardino Basin, Southern California,' by A. L. Sonderegger, contains a description of methods used for this diversion of flood-water. Like most other streams in southern California, the Santa Ana river, after emerging from the mountains, flows across a cone composed of debris deposited by the river. Conservation of flood-water by spreading it over this debris-cone was commenced in 1900.

In 1909 an organization called the 'Water Conservation Association' was formed and a grant of public land in the debris-cone was obtained from the Federal government. This land was worthless for agricultural purposes, being covered with river wash and a scant growth of desert brush. The Association now has 2640 acres under its control.

There is no permanent dam on the Santa Ana debris-cone for the diversion of storm-water. This portion of the work has always been the most difficult. The river carries quantities of debris during floods, with boulders many tons in weight. The construction of a permanent dam on the debris-cone would sooner or later cause a material change in the course of the river, and might lead to extensive damage in the valley below. Therefore, temporary dams only are built, which are washed out with every high flood. In 1915, at the suggestion of W. E. Pedley, of Riverside, a boulder dam was constructed, from 4 to 5 ft. wide on top, with a vertical up-stream slope, and a 1 to 1 down-stream slope; height, from 3 to 6 ft.; length, about 200 ft.; and enclosed with hog-wire mesh of No. 9 and No. 11 gauge. The dam was washed out during the same winter. A similar construction was used during the winter of 1916, special care being taken to protect the down-stream toe with large boulders. The dam withstood the 1916 flood, but a by-pass, about 200 ft. long, was washed out around the western abutment. The dam cost $581 for labor, plus $40 royalty to Mr. Pedley. Such dams will withstand moderate floods and fulfill the purpose for which they are intended. Brush and leaves made the dam fairly tight, approximately 2 sec-ft. seeping away. However, the logical position for diversion-dams is at the mouth of the canyon, where permanent structures can be maintained.

Three methods of spreading are practised. First, from the main diversion-ditch, small streams of 50 miners' inches or less are diverted into furrows, either plowed by teams or made by hand. As long as no cutting occurs in the furrows, the rate of absorption is satisfactory, and the rivulets are not disturbed. During 1915 the maximum wetted area covered by ditches and furrows at any one time did not exceed 50 acres. The diversions varied from 120 to 170 sec-ft. The rate of absorption observed in experiments was 3.42 sec-ft. per acre of wetted area.

The second method consists of building boulder dams in the old channels of the debris-cone, forming small reservoirs or ponds. The dams are built from 6 to 10 ft. high, and made comparatively water-tight by throwing earth against the up-stream face. Nine ponds were constructed, covering a total area of about 2 acres. The ponds, at the beginning of the season, absorb from 2 to 2.3 sec-ft. each; but their absorptive capacity decreases as the bottom becomes silted. At the end of the season they have to be scraped. A third method, tried as an experiment, consisted in the construction of a 5 by 5-ft. timbered pit, 40 ft. deep, and costing $483. Clear water only was admitted, and the absorption did not exceed 0.7 sec-ft. constant flow.

The method of spreading by splitting the stream into furrows is probably the most efficient, although ponds, once constructed, are satisfactory, requiring but little attention. From January 1 to May 31, 1915, one foreman, two men, and one team, were employed in spreading 120 to 170 sec-ft. The total volume of water diverted was 26,527 acre-feet, and the total expenditure $2600. No water is spread during the first day or two of a storm, when the water is muddy, as this would result in objectionable silting.

It has been claimed that large quantities of water spread will evaporate. However, this is not substantiated by facts. The evaporation from still water in southern California varies from 60 to 72 in. per year. In swamps it is approximately 96 in. per year. The evaporation, from January to May 31, is less than one-third of the total for the year. For a wetted area of 50 acres, as observed in 1915, and assuming evaporation from the spreading-grounds equivalent to that from swamps, the total evaporation would not exceed 133.3 acre-feet, which, compared with the total of 26,527 acre-feet of water spread during the same period, would be insignificant.

The first reinforced concrete floating-dock has just been launched at Moss, Norway. It has been built for a Christiania boat-building concern. The length is 80 ft., inside breadth 25 ft., and inside height 16 ft. It has a lifting power of about 100 tons, and has been tested with one of the company's 100-ton reinforced concrete lighters. Inquiries have been received for reinforced concrete floating-docks of as much as 8000 tons capacity. The structure now completed is divided into a number of water-tight compartments, each with its own outlet-pipe, all the pipes leading to the pump-chamber. The centrifugal pump is able to lift the dock with its vessel in the course of an hour. The pump is worked by an electric motor, which receives the current from a generator on shore. Water for submerging enters through outside sluices, of which four are placed at the corners of the dock, two large sluices distributing the water from the pump-chamber to the nine compartments. The outlet-pipes are also made of reinforced concrete.—'Mechanical World'.

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Engineers' Note Book

VERTICAL-CURVE CHARTS

By H. B. THOMSON*

To the engineer or draftsman who has 'laid grades' on mile after mile of highway, a short cut for any part of the work is welcome, provided reasonable accuracy is obtained. The accompanying charts were prepared by me for the purpose of checking rather than to take the place of calculations in the

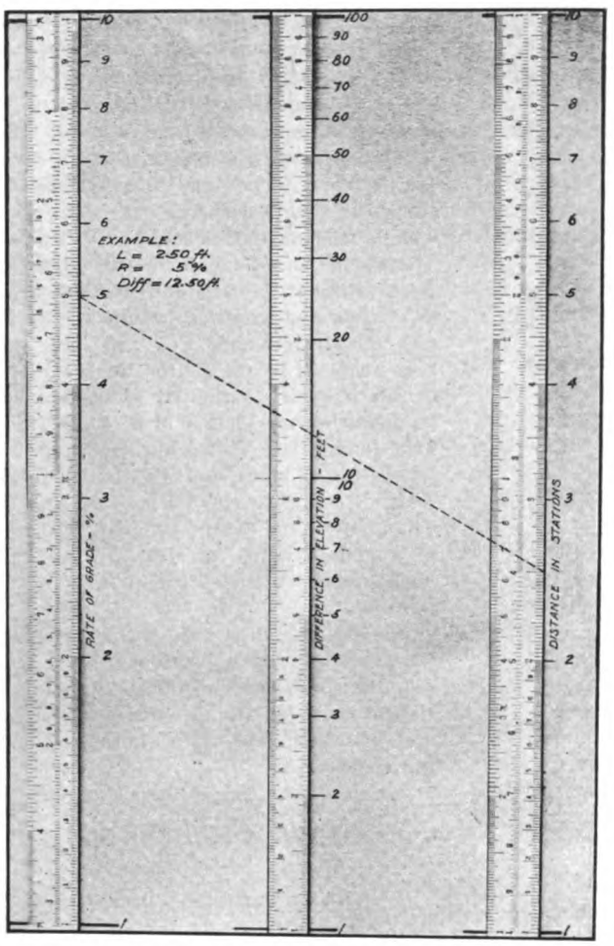

CHART NO. 1. DIFFERENCES IN ELEVATION

office. To the engineer in the field they will be found especially convenient when he is confronted with the task of setting grades on a vertical curve with both speed and accuracy while the contractor waits impatiently for stakes.

Chart No. 1, for obtaining the difference in elevation between two points on a grade where the rate is known, is used by merely laying a straight-edge across the chart and reading the required quantity along this line.

On chart No. 2, knowing the rates of grade on both sides of the curve and the total length of curve, we can determine with two movements of a straight-edge the difference in elevation at any point on the curve between the grade produced and the curve at that point. This may be done with the same accuracy as with an ordinary slide-rule, but with less effort and in a fraction of the time. It is only necessary to remember that the two outside scales are used together, and also the two inside scales, swinging on a common point on the diagonal or 'key-line,' the operation being as follows:

Given a 600-ft. vertical curve, with a back grade of plus 5% and a forward grade of minus 5%, to determine the elevation at 250 ft. from the point of beginning of the curve. Join 6, the curve length in stations, on the left-hand scale 'L', with 10 on the right-hand scale 'D', this being the algebraic sum of + 5 and — 5, and note the point where this line crosses the key-line 'O-O'. Through this point draw a line to 2.5 on the left-hand inside scale 'X', the distance in stations from the beginning of curve to the point required. Produce this line across to the right-hand inside scale marked 'T', which gives the amount in hundredths of a foot to be added to or subtracted from, as the case may be, the elevation for the grade produced

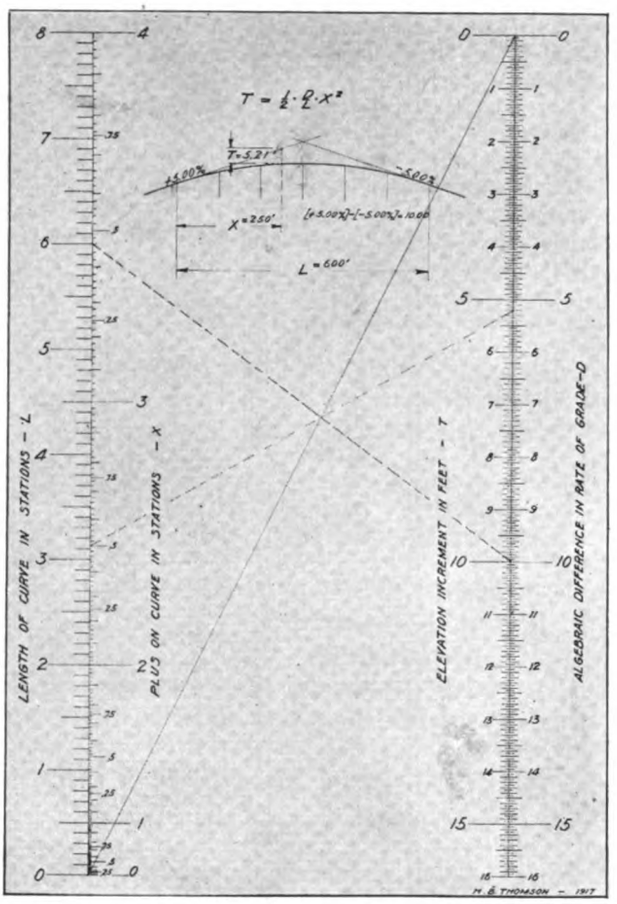

CHART NO. 2. COMPUTATION OF CURVE ELEVATIONS

at the same point. The chart applies to any length of curve, up to 800 ft., and rate of grade to 8%, these being the approximate limits of ordinary work.

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Industrial Progress

CONSTRUCTION OF HIGHWAY FOR HEAVY TEAMING SERVICE

The main driveway across Golden Gate Park from 24th and Fulton to 19th and Lincoln streets, since it is the only road in the Park where heavy trucking is allowed, carries a large amount of traffic. The roadbed has been built at various times by the park forces, and is mainly oil-macadam. This, however, has not 'stood up' under the traffic, ruts 6 in. deep existing in some places. For this reason the road has recently been re-surfaced with E-grade asphaltum and rock, applied so

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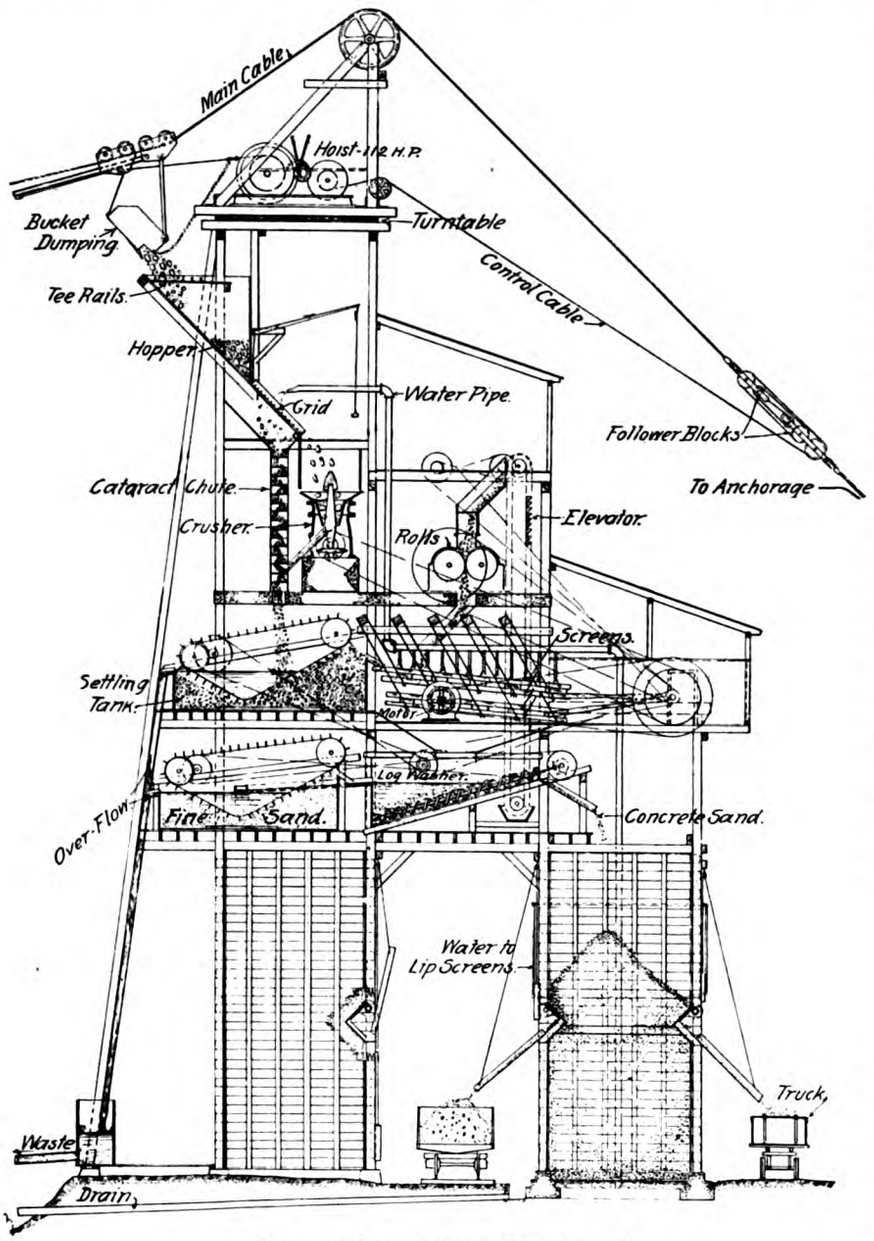
that the minimum thickness when rolled is between ¾ in. and 1 in. First a layer of 1-in. rock is placed, at least 54 lb. to the square yard being used. This is followed by the application of ¾ gal. of asphaltum per square yard, and the surface is then rolled. Then 27 lb. of ¼ to ½ in. rock per sq. yd. is applied, followed by ½ gal. of asphaltum, and the completed surface is rolled again. A small combination heater and sprayer made by the Kinney Manufacturing Co. is used on the work. The tank has a capacity of about 125 gal. and the tank, heater, and hand-pump for spraying are mounted on the same truck. An outfit of this kind is useful for maintenance and small construction jobs.



PLANT OF FRESNO ROCK PRODUCTS CO.

HYDRATED LIME FOR PROMOTING THE FLOW OF CONCRETE IN PIPES AND FORMS

In lining the Twin Peaks tunnel, the concrete was 'shot' through an 8-in. pipe to the forms, in some cases as much as 3000 ft. To promote the flow of the concrete and at the same time to prevent segregation, 8 lb. of hydrated lime was used to 100 lb. of cement. The transportation of concrete was actually easier on a 3% up-grade than on a down-grade.

In constructing the operating-houses for the Belmont Avenue bridge at Chicago, the distance between the inside and outside wall-forms was only 6 in. In addition the space was considerably obstructed by expanded metal and steel reinforcement, giving little room for spading the concrete. Hydrated lime was used in the concrete at the rate of 10 lb. of lime to 100 lb. of cement. In consequence, the concrete flattened so easily that spading was unnecessary and a smooth job was obtained.

THE FRESNO ROCK PRODUCTS CO. PLANT

The Fresno Rock Products Co. was recently organized to operate a gravel-deposit on Kings river in Fresno county. A tract of 125 acres has been secured. Borings show that the gravel is from 50 to 100 ft. deep. The type of plant used is shown in the accompanying illustration, and is the invention of A. D. Hadsell. The Pacific Coast rights in this invention were originally owned and handled by F. W. Woods and assigned by him to the Pacific Cable Excavator Co., and have now been acquired by the Fulton Engine Works of San Francisco. Similar plants are now in operation for C. E. and C. W. Wood at Los Banos, the California Building Materials Co. at Niles, and the Southern California Rock & Gravel Co. at Los Angeles. The plant of the Fresno company will have a working radius of 1000 ft. and the bucket speed will be 1000 to 1200 ft. per minute.

The officers of the Fresno Rock Products Co. are C. W. Wood, president; G. F. Huffschmidt, vice-president; Frank B. Whipple, treasurer; F. W. Woods, secretary and general manager; and A. D. Hadsell, consulting engineer.

New Publications

METHODS OF CLEARING LOGGED-OFF LAND. By C. H. Shattuck. Pp. 59. Ill. Bulletin No. 91. Agricultural Experiment Station, University of Idaho. Describes some practical work in land-clearing done by the experiment station, using various methods, and also gives a general discussion of these methods. Useful to contractors and engineers as well as farmers.

FUNNEL AND ANTICLINAL-RING STRUCTURE ASSOCIATED WITH IGNEOUS INTRUSIONS IN THE MEXICAN OIL-FIELDS. By V. R. Garfias and H. J. Hawley. Re-printed from Bulletin No. 128, American Institute of Mining Engineers. Pp. 13. Ill. Discussion of the geological features of these intrusions and their connection with the occurrence of oil.

SELECTED BIBLIOGRAPHY ON PORTS AND HARBORS. Pp. 144. The American Association of Port Authorities, 29 Broadway, New York. Price, $1. Includes books, magazine articles, and other publications.

EXTRACTION OF GASOLINE FROM NATURAL GAS BY ABSORPTION METHODS. By George A. Burrell, P. M. Biddison, and C. G. Oberfell. Pp. 66. Ill., index. Bulletin No. 120, U. S. Bureau

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of Mines. Describes the use of this process both in the laboratory and on a commercial scale.

THE EFFECT OF MOUTHPIECES ON THE FLOW OF WATER THROUGH A SUBMERGED SHORT PIPE. By Fred B. Seeley. Pp. 48. Ill. Bulletin 96, Engineering Experiment Station, University of Illinois. Describes and gives the results of a series of tests on a number of different kinds of mouthpieces.

Civil Service Examinations

JUNIOR ENGINEER. U. S. Geological Survey. Salary, $1200. Appointment will be assigned to steam-gauging and similar work. Graduation in civil engineering from a college or university of recognized standing required. Applicants will not be assembled for examination and applications will be received at any time. Age limits, 20 to 35. From 10 to 30 appointments will be made in the near future.

Recruits between 18 and 40 are needed in the Enlisted Ordnance Corps, National Army. Skilled men in many different trades are required. Pay ranges from $30 to $97.20 per month, with the usual allowances. Application blanks may be obtained from the Chief of Ordnance, Enlisted Personnel Division, Washington, D. C.

Engineering Societies

IDAHO SOCIETY OF ENGINEERS. Ira F. Schaffner, secretary, Boise.

Los Angeles Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Ford W. Harris, secretary, 1029 Higgins building.

Los Angeles Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Edward Woodbury, secretary, 255 East 3rd street.

OREGON SOCIETY OF ENGINEERS. Orrin E. Stanley, secretary, room 409, City Hall, Portland.

Portland Section, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Paul Lebenbaum, secretary, 45 Union Depot.

Portland Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. J. A. Currey, secretary, 194 North 13th street, Portland.

San Francisco Section of AMERICAN SOCIETY OF CIVIL ENGINEERS. E. T. Thurston, Jr., secretary, Mechanics Institute building.

San Francisco Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Carl F. Braun, secretary, Hooker & Lent building.

San Francisco Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. A. G. Jones, 811 Rialto building.

Southern California Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. Wilkie Woodard, secretary, 435 Consolidated Realty building, Los Angeles.

UTAH SOCIETY OF ENGINEERS. Hugh C. Lewis, secretary, Capitol building, Salt Lake City, Utah.

The regular meeting of the San Francisco Section of Members of the AMERICAN SOCIETY OF CIVIL ENGINEERS was held October 16. M. M. O'Shaughnessy gave the paper of the evening on 'The Tunnels of San Francisco.'

The San Francisco sections of the five national engineering societies gave a joint dinner on October 25 in honor of Ira N. Hollis, president of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Personal

H. T. CORY is at Washington doing Red Cross work.

J. HINMAN has been appointed city manager of Hanford.

H. L. TILLEY is with the California State Highway Commission with headquarters at Hornbrook.

C. E. ALDRICH has been appointed building inspector for the California State Department of Engineering.

CHARLES W. MERRILL has gone to Washington to assist in the work of the National Food Administration.

HARRY W. NEWTON has taken charge of the ore-testing department for Falkenburg & Laucks, of Seattle.

C. A. MACOMBER, formerly manager for the Marin Rock Co., has been appointed city manager of San Anselmo.

M. J. FALKENBURG is in Alaska in connection with the testing-work that his firm is doing for the Alaskan Engineering Commission.

F. B. MCKEVITT, W. S. CARUTHERS, and GEORGE N. RANDLE have been re-appointed members of the Sacramento County Highway Commission.

HOMER HAMLIN, formerly city engineer of Los Angeles, has opened offices as a consulting engineer and geologist at 1103 Central building, Los Angeles.

E. A. STARKE, formerly geologist for the Standard Oil Co., has opened offices as a petroleum engineer in the Trust & Savings building, Los Angeles.

JOHN A. WHISTLER, formerly project manager for the U. S. Reclamation Service, with headquarters at Fallon, Nevada, has gone to Denver to take a position with the Federal Farm Loan Bank.

JOHN E. RICHARDSON, who has been in Chile as engineer for the Guggenheim interests, has been appointed project manager for the U. S. Reclamation Service, with headquarters at Fallon, Nevada.

GEORGE HAWLEY, who has been in charge of construction of the Woodward reservoir of the South San Joaquin irrigation district has been appointed engineer for the East Bay Water Co. He will be connected with the work on the San Pablo dam. He has been succeeded at the Woodward reservoir by C. W. WOOD.

Obituary

JOHN W. DIX, assistant general manager of sales for the Carnegie Steel Co. died April 28.

J. K. ROBINSON, Chilean representative for the Westinghouse Electric Export Co., died at Naples, Maine, September 7.

WILLIAM MATSON died at San Francisco October 11. Starting as a sailor before the mast, he became principal owner of an important line of steamers. He also had large oil and sugar interests. He built the oil pipe-line from Coalinga to Monterey, which was later acquired by the Associated Oil Co. For several years before his death, he was Swedish consul at San Francisco.

Commercial Paragraphs

John E. Woods, formerly manager of sales for the Carnegie Steel Co., Illinois Steel Co., and Tennessee Coal, Iron & Railroad Co., at Cincinnati, has been appointed assistant general manager of sales, succeeding John W. Dix, deceased, with headquarters at Pittsburgh. The advertising and statistical work of the CARNEGIE STEEL CO. has been separated from the sales department and placed in charge of R. B. Woodworth.

An important exhibit of tractors was held at Los Angeles the week commencing September 22.

The SULLIVAN MACHINERY CO. has issued bulletin No. 75-C describing its WJ-3 and WN-4 Angle-compound Compressors, and bulletin No. 75-F, describing its Class WC Tandem-compound Steam-driven Compressors.

The preservation of the metal surfaces in paper-mills is a problem calling for considerable study. The vapors resulting from the various processes tend to corrode the digesters, pipelines, and pumps. ORONITE ENAMEL PAINT has been used successfully to protect these metal surfaces.

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Construction News Summary

STREET AND ROAD WORK

AUBURN, CAL.—Board of Supervisors has appropriated $5000 toward the cost of construction of road from Westville by way of Robinson's Flat to Lake Tahoe. Total estimated cost is $10,000. Application will be made for aid from Federal Government.

BOISE, IDA.—Contract for construction of 17 miles of state highway between Fruitvale and Price Valley has been awarded to Nettleton, Bruce & Eschbach, American Bank Bdg., Seattle, for $75,000.

Contract for graveling 38 miles of the Idaho and Pacific highway in the Burley highway district has been awarded to H. E. Dornell, Dietrich, for $80,000.

COLUSA, CAL.—Construction of county highway system costing $400,000 is proposed.

ELKO, NEV.—Contract for construction of six miles of highway in Jarbidge canyon has been awarded to William Harkins for $18,500.

EUREKA, CAL.—Contract for graveling the Table Bluff road has been awarded to Theodore Wartz for $0.70 per cu. yd. Richard Cloney bid $0.73 and N. E. Johnson, $0.95.

HAMILTON CITY, CAL.—Election will be held November 10 to vote on improvement of highway from Hamilton City to Orland, 14½ miles.

HANFORD, CAL.—Contract for construction of six miles of highway in River Bend district has been awarded to Blanchard-Brown Co., San Francisco, the only bidders, at the following unit prices: excavation, $0.90 per cu. yd.; asphaltic concrete base, $0.0448 per sq. ft.; asphaltic wearing surface, $0.025 per sq. ft.; guard-fence, $0.60 per foot.

HOLLISTER, CAL.—Contract for improvement of part of Rocks road has been awarded to James Hannagan for $1100. W. I. McReynolds bid $1179.

JEROME, ARIZ.—Contract for construction of concrete highway from Jerome to Clarkdale, five miles, has been awarded to Fleming & Stitzer for $65,000.

LOS ANGELES, CAL.—George H. Oswald, Los Angeles, was awarded contract at about $210,000 for improvement of First street. Fairchild-Gilmore-Wilton Co. was the only other bidder.

Contract for construction of six miles of concrete pavement on Reseda avenue has been awarded to G. H. Oswald, O. T. Johnson Bdg., Los Angeles, for $139,662.25.

Contract for improvement of Sherman drive has been awarded to W. M. Ledbetter, Pacific Electric Bdg., Los Angeles, for $28,846.76.

Contract for improvement of Wilton drive has been awarded to G. H. Oswald, O. T. Johnson Bdg., Los Angeles, for $3947.95.

Contract for improvement of Grafton street has been awarded to E. Schelling, 4316 Figueroa street, Los Angeles, for $3801.90.

City council has decided to amend proposed paving specifications so as to permit use of topeka surfacing on the same basis as sheet-asphalt or bitulithic.

MODESTO, CAL.—No bids were received by Board of Supervisors for paving the last 16-mile stretch of the county highway system, and work will be done by day-labor under the direction of county surveyor E. H. Annear.

MOSCOW, IDA.—Contract for placing bituminous top on 38,000 sq. yd. of pavement has been awarded to Standard Asphalt Paving Co., Spokane, at 5.4c. per sq. yd. City will furnish materials.

NAPA, CAL.—Contract for construction of sidewalks on Linn and Seymour streets has been awarded to F. Gaggero, the only bidder, at $157.64.

Contracts for improvement of Montgomery and Monroe streets have been awarded to George Errington for $3164.60 and $3055.59, respectively.

NEZ PERCE, IDA.—Contract for construction of two miles of highway across Lawyer's canyon has been awarded to C. M. Payne & Co., Spokane, at $0.50 per cu. yd. for earth excavation, $0.65 for loose rock, and $1.30 for solid rock, and $155 per acre for clearing. Security Bridge Co., Lewiston, and Jacob Smith, Lapwai, also bid on this work.

OAKLAND, CAL.—Bids will be received until November 5 by G. E. Gross, county clerk, for construction of highway connecting East 14th street with the Dublin boulevard. Estimated cost is $80,000.

Contract for improvement of Hayes street has been awarded to Hutchinson Co., Oakland, at the following unit prices: grading, 2c. per sq. ft.; concrete gutters, 11c. per sq. ft.; oil-macadam pavement, 10c. per sq. ft.; concrete sidewalks, 10c. per sq. ft.; redwood curbs, 11c. per foot.

Contract for improvement of 62nd street has been awarded to Oakland Paving Co., 5000 Broadway, Oakland, at the following unit prices: grading, 3.7c. per sq. ft.; redwood curbs, 15c. per ft.; oil-macadam pavement, 10c. per sq. ft.; concrete gutters, 16c. per square foot.

Contract for improvement of 39th avenue has been awarded to Bernard Ransome, Oakland, at the following unit prices: excavation, $0.45 per cu. yd.; redwood curbs, $0.135 per ft.; concrete gutters, $0.14 per sq. ft.; oil-macadam pavement, $0.095 per sq. ft.; concrete sidewalks, $0.11 per sq. ft.; 8 by 24-in. corrugated iron and concrete culvert, $3.20 per ft.; wooden culvert, $0.70 per foot.

Contract for construction of sidewalks on 8th street has been awarded to J. Catucci, Oakland, for $0.18 per square foot.

OLYMPIA, WASH.—State Highway Commission has awarded the following state highway work:

Olympic highway between Olympia and Kamilche, 3½ miles, including two 50-ft. bridges, to Allred & James, Centralia, for $43,385.63. Sloan Bros. bid $45,168. Engineers' estimate was $45,376.21.

State road No. 21, Charleston to Clifton, 10 miles, to David Govan, Port Angeles, for $78,006.90. Hans Pederson bid $92,002.90. Engineers' estimate was $78,550.90.

Pacific highway between Pioneer and La Center, 3.6 miles, to Arvid Rydstrom, Tacoma, for $44,898.70. Sloan Bros. bid $50,220.75. Engineers' estimate was $48,920.

Sunset highway, west from Wilbur, 4 miles, to G. L. Stickler, Uniontown, for $14,394.20. Spokane Bitumass Paving Co. bid $19,212.29. Engineers' estimate was $14,936.65.

Inland Empire highway from Dayton northerly, to C. N. Pentecost, Walla Walla, for $32,878.

Inland Empire highway from Wallulu easterly to J. W. Hastings, Spokane, for $9005.

Sunset highway, west from Gowan, 8 miles, to G. L. Stickler for $30,954.90. Spokane Bitumass Paving Co. bid $36,261. Engineers' estimate was $22,224.60.

State road No. 22, south from Mercer's Falls, 6 miles, to A. L. Mitchell, Spokane, for $29,254.25. Spokane Bitumass Paving Co. bid $31,790.67. Engineers' estimate was $35,753.86.

PHOENIX, ARIZ.—Contract for improvement of Third street has been awarded to Southwestern Construction Company.

PORTLAND, ORE.—State Highway Commission has awarded contract for macadamizing Pacific highway from Grants Pass to Josephine county line, 8 miles, to Albert Anderson, Grants Pass.

Bids will be received by the State Highway Commission at the November meeting for the following highway work:

In Hood River county between Hood river and Mosier to be graded. Estimated cost is $352,000.

In Josephine county between Wolf creek and Grave Hill creek, to be graded. Estimated cost is $83,000.

In Douglas county between Dillars and Myrtle creek, to be graded. Estimated cost is $173,000.

SACRAMENTO, CAL.—No bids were received for construction of one mile of concrete pavement on the Folsom road and work will be done by day-labor under the direction of supervisor John Russi.

State Highway Commission will receive bids until November 12 for the following state highway work:

In Nevada county between the southerly boundary and Rattlesnake creek, 9 miles, to be graded.

In Monterey county near King City bridge, 3 miles, to be paved with concrete.

In San Luis Obispo county, between Santa Maria river and Arroyo Grande, 12 miles, to be paved with concrete.

Following bids were received by State Highway Commission for highway work:

For work in Sonoma county between Santa Rosa and Willow Brook, 12.4 miles, Municipal Improvement Co., Richmond, was the only bidder and was awarded the contract at the following unit prices: excavation, $0.99 per cu. yd.; 12-in. pipe, $0.60 per ft.; 15-in. pipe, $0.70; 18-in. pipe, $0.80; 24-in. pipe, $1; concrete in culverts and monuments, $12.50 per cu. yd.; concrete in pavement, $5.60; wire-mesh reinforcement, $0.0175 per sq. ft.; guard-rail, $0.40 per ft.; monuments, $2 each; a total of $133,111.20. Engineers' estimate was $121,558.11. State will furnish pipe-railing, reinforcing-steel, wire-mesh re-

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inforcement, corrugated-metal pipe, cement, sand, and coarse aggregate, valued at $81,312.02.

For work in Marin county between the northerly boundary and San Rafael, 16 miles, Edmund J. Treacy, 1st National Bank Bdg., San Francisco, was low bidder and was awarded the contract at the following unit prices: excavation, $1 per cu. yd.; 12-in. pipe, $0.75 per ft.; 15-in. pipe, $1; 18-in. pipe, $1.50; 24-in. pipe, $2; 30-in. pipe, $2.50; concrete in culverts and monuments, $6 per cu. yd; concrete in pavements, $4; reinforcement for pavement, $0.005 per sq. ft.; guard-rail, $0.70 per ft.; monuments, $7 each; a total of $173,347. Other bidders were F. Rolandi, $177,154.90; Palmer & McBryde, $186,265.60; A. J. Fairbanks, $228,296.40. Engineers' estimate was $184,622.04. State will furnish pipe-railing, reinforcing-steel, reinforcement for pavement, corrugated-metal pipe, cement, sand, and coarse aggregate, valued at $103,855.

For work in Butte county between the southerly boundary and Biggs, 7.7 miles, Municipal Improvement Co. was the only bidder and was awarded the contract at the following unit prices: excavation, $0.99 per cu. yd.; 12-in. pipe, $0.60 per ft.; 18-in. pipe, $0.80; 24-in. pipe, $1; concrete in culverts and monuments, $12.50 per cu. yd.; concrete in pavement, $5.74; guard-rail, $0.40 per ft.; monuments, $2 each; a total of $56,240. Engineers' estimate was $46,048.30. State will furnish pipe-railing, reinforcing steel, corrugated-metal pipe, cement, sand, and coarse aggregate, valued at $38,286.15.

Following are the estimates for the proposed additional state highway laterals, the first figure being the estimated cost and the second the State's contribution: Weaverville-Eureka road, $1,175,000, $393,240; Pacheco Pass road, $1,618,413, $541,650; Yosemite road, $533,554, $178,650; Coalinga-San Lucas road, $1,502,538, $502.860; Famosa-Paso Robles road, $1,339,596, $448,320; San Bernardino-Barstow road, $534,112, $178,770; San Bernardino-Yuma road, $2,260,462, $756,510.

SALT LAKE CITY, UTAH.—Contract for paving Gilmer drive has been awarded to Strange & Macguire for $10,961.40.

Contract for construction of sidewalks has been awarded to R. C. Green for $2214.50.

SAN FRANCISCO, CAL.—Contract for improvement of Hamburg street has been awarded to Federal Construction Co., Sharon Bdg., San Francisco, at the following unit prices: excavation, $0.85 per cu. yd.; embankment, $0.10 per cu. yd.; asphalt pavement, $0.23 per sq. ft.; concrete sidewalks, $0.14 per sq. ft.; 21-in. sewer, $2.50 per ft.; 12-in. sewer, $2.25 per ft.; brick manholes, $89 each; 21-in. wye-branches, $2 each; 10-in. pipe culverts, $1.50 per ft.; brick catch-basins, $89 each.

Contract for improvement of Hoffman avenue has been awarded to J. F. Dowling, San Francisco, at the following unit prices: asphalt pavement, $0.55 per sq. ft.; concrete curbs, $0.95 per foot.

Contract for improvement of Ortega street has been awarded to F. R. Ritchie, Chronicle Bdg., San Francisco, at the following unit prices: excavation, $0.50 per cu. yd.; embankment, $0.95 per cu. yd.; concrete sidewalks, $0.15 per sq. ft.; concrete curbs, $0.75 per ft.; brick pavement, $0.40 per sq. ft.; 10-in. vitrified culvert, $1 per ft.; asphalt pavement, $0.22 per sq. ft.; brick catch-basins, $75 each.

Contract for improvement of Hawes avenue has been awarded to H. Crummey Co., Inc., Hearst Bdg., San Francisco, at the following unit prices: 6-in. sewer, $1.50 per ft.; 12-in. sewer, $2; 15-in. sewer, $3; 18-in. sewer, $3.25; 10-in. culvert, $2 per ft.; brick manholes, $90 each; brick catch-basins, $90 each; 18-in. wye-branches, $4 each; excavation, $0.80 per cu. yd.: embankment, $0.20.

Contract for improvement of Clement street has been awarded to C. B. Eaton, 407 11th street, San Francisco, at the following unit prices: excavation, $0.50 per cu. yd.; granite curbs, $1.25 per ft.; concrete sidewalks, $0.13 per sq. ft.; asphalt pavement, $0.22 per square foot.

Contract for improvement of 18th avenue has been awarded to State Improvement Co., Crocker Bdg., San Francisco, at the following unit prices: concrete sidewalks, $0.16 per ft.; asphalt pavement, $0.25 per sq. ft.; concrete curbs, $0.83 per foot.

Contract for improvement of Francisco street has been awarded to J. F. Dowling at the following unit prices: basalt-block pavement with gravel filler on concrete foundation, $0.48 per sq. ft.: basalt-block gutters, $0.48 per sq. ft.; granite curbs, $1.75 per ft.; concrete sidewalks, $0.17 per square foot.

Contract for improvement of Ingalls street has been awarded to Flinn & Treacy, First National Bank Bdg., San Francisco, at the following unit prices: concrete sidewalks, $0.14 per sq. ft.; asphalt pavement, $0.24 per sq. ft.; concrete curbs, $0.80 per ft.; 10-in. vitrified culvert, $1.50 per foot.

Contract for improvement of Bruce avenue has been awarded to T. A. Clark, San Francisco, at the following unit prices: excavation, $1.10 per cu. yd.; embankment, $0.20 per cu. yd.; concrete curbs, $0.80 per ft.; asphalt pavement, $0.2275 per sq. ft.; concrete sidewalks, $0.15 per sq. ft.; brick manholes, $85 each; brick catch-basins, $100 each.

Contract for improvement of 36th avenue has been awarded to Blanchard-Brown Co., San Francisco, at the following unit prices: asphalt pavement, $0.26 per sq. ft.; granite curbs, $1.25 per foot.

Contract for improvement of Balboa street has been awarded to Fay Improvement Co., Phelan Bdg., San Francisco, at the following unit prices: granite curbs, $1.25 per ft.; concrete sidewalks, $0.14 per sq. ft.; asphalt pavement, $0.25 per square foot.

Contract for construction of sidewalks on 25th avenue has been awarded to Frank O'Shea, San Francisco, at $0.114 per square foot.

SAN LUIS OBISPO, CAL.—Board of directors of Valmont Country Club has agreed to construct 4½ miles of macadamized road near Morro Beach.

SANTA BARBARA, CAL.—Contract for paving roads around normal school has been awarded to G. A. Batchelder for $6000.

SANTA ROSA, CAL.—Contract for construction of several stretches of oil-macadam highway in different parts of the county has been awarded to Brush & Howard, Santa Rosa.

SOUTH PASADENA, CAL.—Contract for improvement of Fremont avenue has been awarded to Montgomery & Ducey, 151 South Hill street, Pasadena, for $21,816.

STOCKTON, CAL.—Bids will be received until November 6, by E. D. Graham, county, clerk, for improvement of four miles of county road.

Cy Moreing was awarded contract for construction of five miles of Borden highway at $0.50 per cu. yd. for grading, $2.25 per ton for gravel, and $2.50 per ton for gravel. Lynn Atkinson, Jr., also bid on the work.

SUSANVILLE, CAL.—Boulevard district has been formed to construct highway to State line. Estimated cost is $120,000.

TAFT, CAL.—Contract for paving streets has been awarded to Federal Construction Co., Sharon Bldg., San Francisco, for $58,849.29. Day Construction Co. bid $59,977.90.

THE DALLES, ORE.—Elliott Construction Co., Portland, was low bidder and was awarded contract for construction of Seven Per Cent and Dry-creek highways at $39,115 and $31,008, respectively.

UKIAH, CAL.—Bids will be received until November 12 by Hale Prather, county clerk, for construction of sections No. 1 and 2 of the Elk Creek-Greenwood road.

VALLEJO, CAL.—Contract for improvement of crossing of Branciforte and Capitol streets has been awarded to Worswick Construction Co., Vallejo.

VENICE, CAL.—Contract for construction of concrete pavement and curbs on several streets has been awarded to Venice Contracting Co., Venice, for $4386.62.

VISALIA, CAL.—Board of Supervisors has awarded the following contracts for county highway work: Exeter-Merryman division, Highway Construction Co., Highland, for $72,602.75. Tulare-Paige division to J. E. Lee, Tulare, for $60,800.60. Dinuba-Kingsburg division to Isbell Construction Co., San Diego, for $84,127. Porterville-Woodville division to Brady & Flynn, San Francisco, for $124,970.60.

SEWERS AND DRAINAGE

OCEAN BEACH, CAL.—James Kennedy, Washington Bdg., Los Angeles, was low bidder at $92,394.44 for construction of sewer system. Brown & Julian bid $119,137, and R. A. Wattson, $121,437.

SACRAMENTO, CAL.—Contract for construction of 10 and 14-in. sewers on Stockton boulevard has been awarded to W. J. Tobin, Oakland.

SALINAS, CAL.—Contract for construction of Carr Ditch drainage system has been assigned to George B. La Montague and Robert P. Easley, Antioch.

SALT LAKE CITY, UTAH.—Contract for construction of sewers on Gilmer drive has been awarded to R. C. Green for $5379.69.

SAN FRANCISCO, CAL.—Contract for construction of Trocadero sewer has been awarded to D. L. Bienfield at the following unit prices: 5 ft. 3 in. reinforced concrete sewer with part of invert lined with vitrified brick, $18 per ft.; brick and concrete manholes, $60 each.

Contract for construction of storm-water outlet for Lake street sewer has been awarded to William Lotzin, San Francisco, at the following unit prices: 5 ft. reinforced concrete sewer, $13.75 per ft.; extra heavy section for crossing Lobos creek, $15 per ft.; 4½ ft. reinforced concrete sewer, $12.50; 3 ft. reinforced concrete sewer, $7.50 per ft.; 3½ by 5¼ ft. reinforced concrete sewer with part of invert lined with vitrified brick, $14 per ft.; 12-in. vitrified-pipe sewer, $2 per ft.; 6-in. vitrified-pipe sewer, $0.30 per ft.; brick or concrete manholes,

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$50 each; overflow-structure of reinforced concrete, $400; reinforced-concrete junction-structure, $300; concrete storm-water inlet, $42.50.

UPLAND, CAL.—Contract for construction of interior sewer system has been awarded to E. L. Fleming & Sons, Pomona, for $26,675.

BRIDGES AND CULVERTS

BOISE, IDA.—Contract for construction of several steel bridges on state highways has been awarded to J. H. Forbes, Caldwell, for $27,675.

FRESNO, CAL.—Bids will be received until November 5 by D. M. Barnwell, county clerk, for repair of the North Reedley bridge.

Contract for construction of Belmont avenue bridge has been awarded to I. H. Teilman.

Contract for construction of the Dry Creek bridge has been awarded to Adams & Button.

HANFORD, CAL.—Contract for construction of bridges and culverts on six miles of highway in the River Bend district has been awarded to G. U. Cole, 1318 North Redington street, Hanford, at $12 per cu. yd. for concrete and $0.02 per lb. for placing steel. Blanchard-Brown Co. bid $15.60 and $0.05.

HOLLISTER, CAL.——Contract for construction of three highway bridges has been awarded to W. I. McReynolds.

LOS ANGELES, CAL.—William Ledbetter, Pacific Electric Bdg., Los Angeles, was only bidder for construction of wooden bridges over San Gabriel and Rio Hondo rivers at $49,942 and $44,937, respectively. Bids were rejected and plans will probably be revised.

MERCED, CAL.—All bids for construction of bridge in district No. 2 have been rejected because too high.

Contract for construction of bridge in district No. 3 has been awarded to Boney & Wilcox, for $7282.

Contract for construction of bridge in district No. 1 has been awarded to R. V. Heuvel for $1283.

PORTLAND, ORE.—Contract for construction of bridges over the Chehalis river and the Skookumchuck river for the Oregon-Washington Railroad & Navigation Co. has been awarded to Nettleton-Bruce-Eschbach Co., American Bank Bdg., Seattle.

RED BLUFF, CAL.—Contracts for construction of reinforced concrete bridges on state highway across Jackson creek and Truckee creek have been awarded to C. E. McCartney and E. L. Taylor, for $3100 and $2789, respectively. Contracts for construction of similar bridges across McClure creek and Elder creek have been awarded to Teel & Thompson for $7400 and $9900, respectively.

Contract for construction of wooden bridge across Thomas creek has been awarded to Lanning & Nohn, for $1340.

SACRAMENTO, CAL.—Following bids were received by State Highway Commission for construction of three reinforced concrete bridges on the state highway in Shasta county: Alfred H. Vogt, $15,795; Tieslau Bros., $15,900; Conners, Green & Co., $16,476. Engineers' estimate was $14,762.08. All bids were rejected.

SALINAS, CAL.—Contract for repairing the Rock Creek bridge has been awarded to J. M. Sutherland for $682.25.

SAN RAFAEL, CAL.—Contract for construction of concrete bridge on state highway near Novato has been awarded to W. L. Proctor for $2947.80 for the bridge, and $1.15 per ft. for piling. Ghilotti Bros., S. P. Brownlee, and Thompson Bridge Co., also bid on this work.

Contract for construction of Ignacio bridge has been awarded to Ghilotti Bros. for $2099. W. L. Proctor bid $2719, and S. P. Brownlee $3600.

SANTA BARBARA, CAL.—Contract for construction of pile-trestle bridge on Lompoc-Solvang road has been awarded to Mercer-Fraser Co., Eureka, for $2146.

Contract for construction of a pipe-line suspension-bridge over Santa Ynez river for Associated Oil Co., has been awarded to Mercer-Fraser Co., Eureka, for $25,000.

TRACY, CAL.—West Side irrigation district has awarded contract for construction of pile-bridge to Jacobs & Sayles, Stockton, for $2488.

UKIAH, CAL.—Contract for construction of Redwood Valley bridge has been awarded to Orr & Horr for $1389.30. Al Carlson bid $1390, and L. R. Whited $1669.

Contract for construction of Gold creek bridge has been awarded to Orr & Horr, for $1367.

VENTURA, CAL.—Bids will be received until November 9 by J. B. McCloskey, county clerk, for construction of 6 by 6 ft. reinforced concrete culvert four miles from Saticoy.

Contract for construction of a reinforced concrete culvert on the Foothill road near Ventura has been awarded to G. H. Jordan, 1323 Hawthorne street, Glendale, for $1270.

Contract for construction of a reinforced concrete culvert near Saticoy has been awarded to G. G. Noble, 1135 West 39th street, Los Angeles, for $1120.

YREKA, CAL.—Contract for construction of bridge on state highway near Edgewood has been awarded to C. L. Noel and A. S. Calkins, Yreka, for $5198.

IRRIGATION AND WATER SUPPLY

ALTURAS, CAL.—Surprise Valley irrigation district has been formed. Water for irrigating 20,000 acres of land will be obtained from Cowhead lake. James Foreman, W. H. Scamp, and George Ayers are interested.

EL PASO, TEX.—Bids will be received until November 15 at office of U. S. Reclamation Service, for construction of canals on the Rio Grande project, requiring 22,000 cu. yd. excavation. Work is near Garfield, New Mexico. Plans are on file at office of 'Western Engineering.'

ENTERPRISE, ORE.—Twohy Bros. have sublet contract for construction of 16 miles of canals on the Ochoco project to Ross Newport for $100,000.

FRUITLAND, IDA.—Contract for construction of irrigation system covering several thousand acres of land in this vicinity has been awarded to Maney Bros., Boise, for $175,000.

KLAMATH FALLS, ORE.—Contract for construction of Big Springs irrigation project has been awarded to C. T. Darley. Work includes dredging, and the construction of a dam, pumping plant, and concrete intakes and outlets.

MANHATTAN BEACH, CAL.—Contract for furnishing and laying 2-in. water-pipe on several streets has been awarded to V. W. Sparks, for $3615.49.

MANTECA, CAL.—Keystone Construction Co. has been released from its contract for construction of dams at reservoir of South San Joaquin irrigation district, and work will be completed by day-labor.

NORTH YAKIMA, WASH.—Owners of 2000 acres of land above the Sunnyside canal north of Prosser, have approved proposal of the Government to construct pumping plant and canals. Estimated cost is $220,000.

OAKDALE, CAL.—Burton Smith is preparing plans for improvement of system of Oakdale irrigation district. Estimated cost is $50,000, of which $25,000 is for concrete lining for main canals.

SAN DIEGO, CAL.—Contract for construction of Lower Otay dam has been awarded to James Kennedy Co., Los Angeles, for $586,735.

SAN FRANCISCO, CAL.—State Water Commission has issued the following permits to divert water:

Ed Fletcher, San Diego, 8 second-feet from Escondido creek for irrigation. Plans include concrete dam 140 ft. high and main canal two miles long. Estimated cost is $250,000.

W. F. Fowler, Willows, 250 second-feet from Sacramento river for irrigation. Point of diversion is at Sidds Landing. Plans include centrifugal pumps, motors, and canals. Estimated cost is $180,000.

River Farms Co., San Francisco, 276 second-feet from Sacramento river at various points for irrigation. Plans include pumps, motors, and canals.

State Water Commission has received the following applications for permission to divert water:

United Light & Power Co., Los Angeles, 15 second-feet from San Gabriel river for power. Plans include multiple-arch concrete dam, and a tunnel and pipe-line 2½ miles long. Estimated cost is $300,000.

Baxter Creek irrigation district, Lassen, 4000 acre-feet from streams in Lassen county. System is now under construction.

Littlerock Creek irrigation district, Littlerock, all unappropriated water from Littlerock creek for irrigation. Plans include multiple-arch concrete dam. Estimated cost is $160,000.

E. M. McCardle and J. G. Roberts, Madera, as trustees of proposed Madera irrigation district, all the water of Fine Gold creek for irrigation.

Happy Valley irrigation district, Olinda, 7336 acre-feet from tributaries of Cottonwood creek in Shasta county. Plans include three diversion-dams, two storage-dams, and a tunnel and canal 25 miles long. Estimated cost is $353,000.

Princeton-Codora-Glenn irrigation district, 120 second-feet from Sacramento river. Plans include two centrifugal pumps operated by 225-hp. motors, and main canal five miles long. Estimated cost is $30,000. This is in addition to the Sidds Landing diversion.

Reclamation district No. 108, Grimes, 500 second-feet from Sacramento river for irrigation. Plans include canal 16 miles long. Estimated cost is $75,000.

Duryea, Haehl & Gilman, Humboldt Bank Bdg., San Francisco, an irrigation project on the Mokelumne river. Estimated cost is $10,500,000.

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Thomas O'Brien, Lebec, 50 second-feet from Cuddy creek for irrigation and power. Plans include several rock and earth dams and about four miles of ditch. Estimated cost is $7000.

W. J. and P. S. Dorris, Alturas, 2700 acre-feet from tributary of Pit river for irrigation. Plans include concrete and earth dams and ditches. Estimated cost is $5500.

C. L. Lemm and J. G. Chatham, Bella Vista, 80 second-feet from tributary of Pit river for irrigation. Estimated cost of work is $10,000.

Clarence W. Guerin, Pomona, 150,000 acre-feet from south fork of Kern river for irrigation. Plans include tunnel, pipeline, and canal 45 miles long.

SAN RAFAEL, CAL.—Marin Municipal water district has awarded contract for driving Porteous tunnel to J. M. DeLuca, San Francisco, for $3330. Cahill-Vensona Co. bid $6920. Engineer's estimate was $3150.

SANTA BARBARA, CAL.—J. A. Clarey has been awarded contract for construction of concrete reservoir for J. H. Moore.

Contract for construction of Mission Ridge reservoir has been awarded to A. L. Pendola, 1332 Garden street, Santa Barbara, for $51,112.40.

STOCKTON, CAL.—Board of Supervisors has granted petition for formation of Woodbridge irrigation district, containing 15,574 acres.

TRACY, CAL.—Contract for construction of two divisions of canal for West Side irrigation district has been awarded to Johnson Bros., Tracy.

Contract for construction of another division has been awarded to C. H. Laibin, Manteca.

LIGHT, HEAT, AND POWER

LIVINGSTON, CAL.—Formation of lighting district has been ratified at election.

PENTICTON, B. C.—Kootenay Power Co. will spend $2,500,000 on power-lines in this vicinity.

SALEM, ORE.—Pacific Telephone & Telegraph Co. will rebuild line between Salem and Chemawa. Estimated cost is $14,000.

SAN FRANCISCO, CAL.—Contract for furnishing and installing lighting fixtures in the north-east wing of the San Francisco Hospital has been awarded to Roberts Manufacturing Co., San Francisco, for $6216.

SAN FRANCISCO, CAL.—Contract for brick and terra-cotta work for central heating-plant at county jail No. 2 has been awarded to Anderson & Ringrose for $2230.

SAN FRANCISCO, CAL.—Contract for electric work in connection with yard work on north-east wing of San Francisco Hospital, has been awarded to J. W. Burtchaell, 357 Ellis street, San Francisco, for $4789.

RIVER AND HARBOR WORK

MARTINEZ, CAL.—Contract for enlarging docks of Shell Oil Co. has been awarded to Hyde, Harjes & Co., San Francisco.

SALINAS, CAL.—Contract for construction of bank-protection on the Big Sur river has been awarded to A. J. Molera for $850.

SAN FRANCISCO, CAL.—Thomson Bridge Co., 103 Main street, San Francisco, was low bidder and was awarded contract at $26,470, for re-construction and repair of wharf at quarantine-station. Other bidders were: Healy-Tibbitts Construction Co., $26,880; Duncanson-Harrelson Co., $26,894; Hyde, Harjes & Co., $28,330; Tibbitts-Pacific Co., $34,900; San Francisco Bridge Co., $39,448.

SAN FRANCISCO, CAL.—Contract for re-constructing pier No. 42 has been awarded to Healy-Tibbitts Construction Co., Main and Market streets, San Francisco, for $113,723.

SEATTLE, WASH.—Bids will be received until November 13 by county commissioners for construction of wooden dock at Mercer island.

RAILROAD WORK

OLYMPIA, WASH.—Contract for construction of undergrade crossing on Pacific highway under Great Northern tracks between Blanchard and Burlington, has been awarded to J. R. Wood, 621 Valley street, Seattle, for $36,838. Skagit Construction Co. bid $38,071. Engineers' estimate was $36,433.

PENTICTON, B. C.—Kettle Valley Railway Co. will construct line from Penticton to Copper Mountain, 14 miles. Estimated cost is $1,000,000.

QUINCY, CAL.—Assets of Quincy Western Railroad will be purchased by the Quincy Lumber Co., and the operation of the line continued.

SAN FRANCISCO, CAL.—Clear Lake Railroad Co. has filed an amended application with the State Railroad Commission for permission to construct railroad from Hopland to Lakeport, 22 miles. It is proposed to issue $500,000 in bonds and $150,000 in stock.

BUILDING CONSTRUCTION

ANDERSON, CAL.—Contract for construction of high-school building has been awarded to Trevia & Pasqualetti, 400 Bay street, San Francisco, for $31,130. Contract for heating system has been awarded to J. C. Hurley Co., San Francisco, for $3345.

BAKERSFIELD, CAL.—Contract for construction of gymnasium-building for high-school has been awarded to Currie & Dulgar, Bakersfield, for $51,000.

BENICIA, CAL.—Contract for construction of class C building for Kullman-Salz Co. has been awarded to Ira W. Colburn, 180 Jessie street, San Francisco, for $15,000.

CAPISTRANO, CAL.—Contract for construction of concrete sub-station for Southern California Edison Co. has been awarded to Willard-Brent Co., Baker-Detwiler Bdg., Los Angeles, for $23,000.

CENTRALIA, WASH.—Contract for construction or high-school buliding has been awarded to Sylliaasen & Sando, Downs Bdg., Seattle, for $36,495.

CHINO, CAL.—Contract for construction of buildings for George Junior Republic has been awarded to Cresmer Manufacturing Co., Riverside, for $19,273.

HEALDSBURG, CAL.—Contract for construction of high-school building has been awarded to Anderson & Ringrose, San Francisco, for $68,493.

LORDSBURG, CAL.—Contract for construction of dormitory-building for Lordsburg College has been awarded to Hannawalt & Moomaw, La Verne, for $30,760.

LOS ANGELES, CAL.—Contract for construction of cafeteria-building at Los Angeles high-school has been awarded to Willard-Brent Co., Baker-Detwiler Bdg., Los Angeles, for $28,119.

Contract for construction of brick building for L. M. Boothe has been awarded to De Luxe Building Co., Union League Bdg., Los Angeles, for $16,573.

Contract for construction of building for Lugo school has been awarded to A. L. Gribling, 217 East Avenue 33, Los Angeles, for $24,000.

Contract for construction of reinforced concrete and brick power-house and a concrete-lined tunnel for city has been awarded to Lee Callahan, 2324 Michigan avenue, Los Angeles, for $28,793.

MANHATTAN BEACH, CAL.—Contract for construction of municipal pavilion has been awarded to W. M. Bell, 1046 West 92nd street, Los Angeles, for $19,693.

MARYSVILLE, CAL.—Contract for construction of concrete hospital-building has been awarded to I. C. Evans, Marysville, for $40,000.

OAKLAND, CAL.—W. H. Judson, Blake Bdg., Oakland, is preparing plans for an $80,000 apartment-house and for a $65,000 hotel.

Contract for construction of brick addition to factory of Oakland Mazda Lamp Works has been awarded to Schnebly & Hostrauser, 6th and Jackson streets, Oakland, for $85,500.

Contract for construction of concrete garage, boiler-house, and tank-vault for Albers Bros. Milling Co. has been awarded to Masow & Morrison, Monadnock Bldg., San Francisco, for $12,000.

OLEUM, CAL.—Contract for construction of dormitory building for Union Oil Co. has been awarded to Matthew Morton, Richmond, for $28,000.

OLYMPIA, WASH.—Contract for construction of State building at Retsil has been awarded to Western Construction Co., 1717 East 55th street, Seattle, for $16,169.

RICHMOND, CAL.—Contract for construction of frame apartment-house for H. F. Brown has been awarded to Carl Overaa, Richmond, for $18,399.

RIVERSIDE, CAL.—D. B. Whiteside will construct $175,000 hotel.

SACRAMENTO.—Harvey Garber, Orange, was low bidder for construction of building for Southern California State Hospital at Patton for $45,906.

State architect G. B. McDougall is preparing plans for buildings at State Fair grounds, to replace structures destroyed by fire. Estimated cost is $300,000.

Deed to land for new Capitol buildings has been turned over to State. This clears the way for construction of buildings. Estimated cost is $3,000,000.

J. A. McCullough, 1015 23rd street, Sacramento, will have charge of construction of plant for Liberty Iron Works, which

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has contract for construction of aeroplanes for Government. Buildings will be of reinforced concrete.

SAN BERNARDINO, CAL.—Contract for construction of brick building for O. C. Cohn has been awarded to Phillips & LeClaire for $13,200.

SAN CARLOS, CAL.—Contract for construction of school-building has been awarded to Hurlburt & Kellaw, San Carlos, for $9827.

SAN FRANCISCO, CAL.—Contract for construction of bulk-head-wharf building on pier 46 has been awarded to Clinton Construction Co., San Francisco, for $20,450.

Edwin J. Symmes, Pacific Bldg., San Francisco, is preparing plans for hospital and administration building to be erected by Federal Government in Yosemite valley.

C. L. Wold Co., 75 Sutter street, San Francisco, was low bidder at $8498, for construction of marine barracks at Tiburon.

Contract for steel and iron work for addition to Hotel Stewart has been awarded to Central Iron Works, 631 Florida street, San Francisco, for $17,600.

Contract for construction of brick building for Warehouse Investment Co. has been awarded to Lindgren Co., Monadnock Bdg., San Francisco, for $100,000.

Contract for construction of the Newhall building has been awarded to Dinwiddie Construction Co., Crocker Bdg., San Francisco, for $100,000.

Contract for construction of brick factory-building for John Center Co. has been awarded to C. W. Gompert, 503 Market street, San Francisco, for $32,000.

Contract for construction of frame apartment-house for M. A. Hrubami has been awarded to C. Alsup, Hearst Bdg., San Francisco, for $32,500.

Contract for construction of addition to Hotel Stewart has been awarded to Knowles & Mathewson, San Francisco.

Contract for construction of brick apartment-house for Calhoun Bryant has been awarded to William Martin, 110 Jessie street, San Francisco, for $33,950.

Contract for foundation and concrete work for Young Women's Christian Association building has been awarded to Anderson & Ringrose, San Francisco.

Contract for alterations in Nevada Bank building has been awarded to H. J. Hansen, 1327 20th avenue, San Francisco, for $20,308.

Contract for excavation and concrete work for Exchange Realty building has been awarded to Clinton Construction Co., San Francisco, for $42,060.

Schroder Bros., 565 Folsom street, San Francisco, were low bidders at $30,446, for construction of medical-ward barracks at Goat Island.

SAN JOSE, CAL.—Binder & Curtis are preparing plans for $100,000 theatre-building.

SAN PEDRO, CAL.—American Trona Co. will construct reinforced concrete warehouse by day-labor.

SANTA MARIA, CAL.—G. M. Doany, Santa Maria, was awarded contract at $25,000 for construction of building for First National Bank of Santa Maria.

STOCKTON, CAL.—Contract for construction of building for F. D. Naylor has been awarded to James Mulcahy, Stockton. Estimated cost is $40,000.

National Paper Products Co. will construct reinforced concrete buildings for paper-mill. Estimated cost is $1,000,000. MacDonald & Kahn, Rialto Bldg., San Francisco, are architects.

TACOMA, WASH.—Contract for construction of four-story brick building for Lindberg Grocery Co. has been awarded to E. Young, 814 South Cushman street, Tacoma.

TROPICO, CAL.—T. P. Ross, 310 California street, San Francisco, has completed plans for mausoleum for Forest Lawn Memorial Park. Estimated cost is $250,000.

VALLEJO, CAL.—Contract for construction of building for Association of Mare Island Employes has been awarded to Hyde, Harjes & Co., San Francisco, for $8430. Healy-Tibbitts Construction Co. bid $8674.60.

VANCOUVER, B. C.—Concrete for construction of concrete train-sheds and platforms for Canadian Northern Railway has been awarded to Northern Construction Co., Vancouver Block, Vancouver, for $150,000.

Contract for construction of brick school-building at Rossland has been awarded to R. Moncrieff, Regent Hotel, Vancouver.

WASHINGTON, D. C.—R. E. Campbell, Salt Lake City, was low bidder for construction of post-office at Twin Falls, Idaho, at $75.443 for either limestone or sandstone.

WHITTIER, CAL.—Contract for construction of chemistry building for Whittier College has been awarded to G. A. Daniel, 916 Herkimer street, Pasadena, for $25,211.

BONDS

ARCATA, CAL.—Bond issue for $60,000 for construction of high-school building has been voted.

BUHL, IDA.—Bond issue of $400,000 for construction of highway system has been voted.

CHENEY, WASH.—Bond issue of $20,000 for construction of street improvements has been voted.

COEUR D'ALENE, IDA.—Bond issue of $25,000 for construction of highway to Wallace has been voted. Total estimated cost is $150,000, the remainder to be furnished from Federal, State, and county funds.

EL CAJON, CAL.—Bond issue of $11,500 for construction of state highway through town has been defeated.

ESCONDIDO, CAL.—Bond issue of $540,000 has been voted. Money will be used for street improvements, construction of city hall, and purchase of fire-apparatus.

GOLD HILL, ORE.—Bond issue of $60,000 for construction of gravity irrigation system has been voted.

HAMILTON CITY, CAL.—Bond issue of $20,000 for construction of school-building has been sold to Cyrus Pierce & Co., San Francisco, for $20,027.70. The bonds bear 5% interest.

HERMOSA BEACH, CAL.—Bond issue of $100,000 for harbor improvements has been voted.

PORTERVILLE, CAL.—Suit has been filed, contesting the validity of the $30,000 bond issue recently voted for the construction of bridges.

RENO, NEV.—Bond issue of $32,000 for construction of school-building has been voted.

SAN DIEGO, CAL.—City council has sold the bond issue of $682,200 for construction of the Lower Otay dam to G. C. Blymyer Co., San Francisco, at par and accrued interest.

SANTA BARBARA, CAL.—Bond issue of $25,000 for construction of fire-house has probably been defeated.

SEAL BEACH, CAL.—Election will be held November 12 to vote on bond issue of $45,000 for construction of municipal water system.

TERRA BELLA, CAL.—Sale of $100,000 worth of bonds of the Terra Bella irrigation district, bids for which were to have been received on September 29, has been postponed.

VALLEJO, CAL.—Election will be held on November 16 to vote on bond issue of $60,000 for construction of school-building.

VISALIA, CAL.—Bonds for $900,000, the last of the $2,200,000 issue for construction of county highway system have been sold, $300,000 to R. H. Moulton & Co., Los Angeles, and the remaining $600,000 to the First National Bank of Exeter.

MACHINERY AND SUPPLIES

OLYMPIA, WASH.—County commissioners will receive bids until November 12 for the sale of some second-hand bridge steel, including 68,972 lb. of I-beams and one complete 80-ft. pony-truss bridge.

SACRAMENTO, CAL.—Shell Oil Co. was the only bidder at $1.70 per bbl. for furnishing fuel-oil to city.

SAN DIEGO, CAL.—Golden State Portland Cement Co. was low bidder at $1.53 per bbl. net f. o. b. San Diego, for furnishing 13,500 bbl. cement for construction of highway from city limits to Camp Kearny.

SAN FRANCISCO, CAL.—Baker-Hausen Manufacturing Co. has been awarded contract for furnishing a distillate-engine and compressor for the Southampton Shoal light-station.

MISCELLANEOUS

COQUILLE, ORE.—Bids will be received until December 5 by L. W. Oddy, county clerk, for furnishing a 65-ft. ferry-boat.

FRESNO, CAL.—Contract for moving gas-container to new sub-station has been awarded by Pacific Gas & Electric Co. to Duncanson-Harrelson Co., San Francisco, for $34,980.

OAKLAND, CAL.—City council has granted lease of 37 acres of waterfront property to A. J. Woolsey.

OILPORT, CAL.—Contract for wrecking and hauling 2800 tons of material from the old Oilport refinery, 4.7 miles, to the railroad, has been awarded to J. P. Plaugher, Taft.

REDWOOD CITY, CAL.—Contract for fencing part of La Honda road has been awarded to A. D. McLellan for $1592.50. Pacific Fence Co. bid $1668.35, and John Mork $2195.20.

SAN DIEGO, CAL.—B. F. Graham has leased land from city for shipbuilding plant and has agreed to spend $250,000 within one year.

SAN RAFAEL, CAL.—Contract for fencing 14,500 ft. of state highway between San Rafael and Petaluma has been awarded to R. Leonhart for 12c. per ft. Joseph Williams bid 12.5c., and W. Vanning, 13.5c.

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